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ABSTRACT

Twelve papers are contained in this report. Robert M. Ranftl reports on the findings of a study to identify useful techniques for optimizing productivity. John S. Packard contrasts the spirit of inquiry and the norm of productivity, and makes recommendations for the composition of a research team. David L. Williams describes procedures to ensure research and development productivity and effectiveness. Hank Becker discusses incentives and constraints that may be imposed to assist individual researchers in their goal to be more productive. Virginia L. Thompson presents a developer's view of the critical elements necessary to ensure productivity and effectiveness. Carl J. Lyons presents a general management theme and some elements in its implementation. Alexander J. Field states that the productivity and effectiveness of educational research and development is primarily a function of its impact on the educational system itself. Leslie Salmon-Cox discusses some evidence of productivity and effectiveness defined in terms of characteristics of knowledge production. P. Michael Timpane discusses the limitations of the procurement process. Wallace H. Wulfeck talks about how the Navy Department attempts to ensure productivity and effectiveness in educational research and development. George Shollenberger comments on defining performance measures for the National Institute of Law Enforcement and Criminal Justice. Margaret K. Chandler's comments on future requirements for research and development effectiveness conclude the proceedings. (MLF)

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IN EDUCATIONAL RESEARCH AND DEVELOPMENT

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Session 1

IMPROVING R & D PRODUCTIVITY: A STUDY PROGRAM AND ITS APPLICATION

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R & D productivity is a complex and elusive subject involving the interaction of many variables. Not only are the more tangible factors of technical performance, time, cost, quality, reliability, etc., involved, but also the less tangible factors such as work environment, motivation, attitude, etc.

Furthermore, determining the true productivity impact of an r & d effort requires a suitable period for evaluation. Efforts that appear to produce productivity gains in the short term for example may result in long-term losses, and vice versa. In addition, short-term efficiency at the forefront of technological innovation may be low. But the long-term significance of the output may be high. In r & d, it is predominantly the long-range impact of the output that is important.

An extensive study of r & d productivity was conducted in 1973 and 1974 by Hughes Aircraft Company. The goal of the study was to identify useful techniques for optimizing productivity in an r & d environment. The study encompassed not only traditional research and development efforts, but also key interfacing activities--contracts, finance, marketing, material, manufacturing, support, and services. The primary thrust of the study was to gather data directly from a broad spectrum of knowledgeable individuals--executives, managers, scientists, engineers, consultants, and educators--with extensive experience in r & d.

The study included surveys of 27 industrial, governmental, and educational organizations; interviews with 13 prominent consultants; and a comprehensive literature search in cooperation with 12 major libraries, government organizations, professional associations, and other special information sources.[1] Since little material was found specifically on r & d productivity, the task was approached by researching each facet of the subject individually. Results of the two-year study effort were summarized in a 129-page, book-type report entitled "R & D Productivity," published by Hughes in December 1974.[2] As the Hughes study bears out, the specific means for improving productivity are unique to each individual and organization; there is no universal formula. The primary purpose of the study report, therefore, is to stimulate readers into thinking about productivity and subsequently taking action to improve both their personal productivity and that of their particular organizations.

This paper, summarizing the major points of Mr. Ranftl's presentation to the National Conference on Productivity and Effectiveness in Educational Research and Development, appears here with the permission of Research Management Journal, in which it was published in January 1977.
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The study report, in its entirety, stresses that professional management and productivity are inseparable. The main path to improved productivity is through effective management and leadership, high operating standards, optimal application of all resouces, a creative environment, strong people-orientation, effective communication, cost consciousness, and simplicity in all operations.

Since employees take their cues from management, it is particularly important that management clearly convey (1) its feeling of the importance of productivity, and (2) its strong desire to see active productivity improvement efforts throughout the organization. Furthermore, according to the study, the greatest productivity improvement results when management takes a systems approach, emphasizing effective tradeoff decisions within the activities where improvement is desired.

The following management actions were identified in the study as conducive to achieving high productivity:

- Keeping the organization "tuned up"; always searching for more productive ways of doing things
- Continually reappraising approaches to planning, organizing, staffing, directing, and controlling
- Encouraging technological innovation and the use of technological aids
- Eliminating all unnecessary functions; not wasting effort trying to improve the efficiency of parasitic operations
- Managing time carefully; always considering priorities and potential gains when making an investment of time
- Controlling operating funds effectively--the "penny-saved" approach
- Promptly eliminating unnecessary redundancy
- Applying work elimination, simplification, and standardization techniques
- Encouraging healthy competition between groups or with other organizations as a stimulus to improving overall productivity

Unfortunately, not all efforts to improve productivity succeed. Reasons for failure--as noted by study participants include:

- Lack of sufficient innovation--always doing things "the same old way." (Methods of operation must be continually questioned or productivity will tend to "freeze" at a suboptimal level.)
- Ineffective implementation of otherwise effective plans for improving productivity
- Improving productivity of one function at the expense of another

- Short-term improvements that prove counterproductive in the long run

- Overenthusiasm or underenthusiasm about improving productivity. (It is important to maintain proper perspective and consistent pace.)

To afford the reader a brief insight into the report's contents, a sample of the numerous study findings is included herein.

One feature of the Hughes study is a set of productivity profiles. During the study, the many professionals interviewed were asked what indicators they found most useful in identifying productive employees, managers, and organizations. Although responses were expressed in a variety of ways, they consistently focused on certain characteristics. The characteristics are presented in the study report as (1) The Profiles of a Productive Employee, (2) The Profile of a Productive Manager, and (3) The Profile of a Productive Organization. For the interest of the reader, the Profile of a Productive Organization is also reproduced herein.

A Program for Improving R & D Productivity

After completing its initial study of r & d productivity, Hughes initiated an internal action-oriented productivity improvement program in January 1975. The primary steps in the program were as follows:

1. Top management launched the program by distributing the study report to 6,500 key personnel. Recipients included all levels of line and staff management and corresponding levels of senior technical personnel. Each copy was accompanied by a personal letter from top management encouraging its study and use.

2. Four months later, top management conducted a sample survey of 2,000 line and staff management personnel asking them to identify any counterproductive factors within the organization that they felt warranted attention. The request solicited candid responses in each person's own words. Participation was entirely voluntary, and there was no requirement to respond or to sign replies. The 1,200 comments received were carefully studied, sorted, and combined, forming a list of 17 counterproductive factors.

3. Top management conducted a follow-on survey of the same 2,000 personnel. This survey identified the 17 counterproductive factors and requested suggestions for solution. The 1,400 comments received were carefully analyzed and combined, forming a composite list of 70 recommendations.

4. Each of the 17 counterproductive factors and 70 recommendations is currently being thoroughly studied by a senior management team. A number of actions have been taken, and others will follow. In carrying out these actions, the management team draws on whatever company resources it deems necessary. Information on specific actions implemented is being communicated by means of productivity improvement letters from top management to the 6,500 key personnel who originally received the study report. This provides the feedback that is so important to the success of the program.

5. To support the productivity improvement program, voluntary training courses in personal, organizational, and managerial productivity were initiated in January 1975. Courses consist of 10 sessions, 2-1/2 hours each, and are offered after normal working hours. To date, 17 such courses have been offered, and all have been heavily subscribed. Of particular significance, both the president of Hughes Aircraft Company and the assistant general manager devote an evening to personally participate in every course. Such participation includes the sharing of their personal management philosophies, the discussion of company objectives, and the spontaneous answering of questions--all in a very relaxed and informal atmosphere.

The formal internal surveys--identifying counterproductive factors and related solutions--have been completed; emphasis is now on corrective action. However, recognizing that productivity improvement is a never-ending process, top management have requested that, on a continuing basis, comments and suggestions concerning company productivity be sent directly to them for appropriate attention.

A Backward Glance

Reflecting on the Hughes productivity program, several factors stand out as contributing significantly to its success. These factors are identified below with the thought that some of them may be of interest to readers contemplating a similar program within their organizations.

- A systems approach was taken, treating all company operations.
- A low-profile, sensibly paced, professional approach was consistently pursued with emphasis always focused on action. Overnight results were never anticipated, but significant long-term productivity gains are expected.
- Strong, visible top management support was always evident throughout the program.
- Care was taken to ensure that productivity did not become an end in itself, or a cult. There was never any trace of sensationalism or drumbeating, and the word productivity was not permitted to degenerate into a buzz word.
- Productivity improvement was treated as a normal line-management function, with each organization and each individual encouraged to productively perform in position. There were no corporate edicts, surveillance staffs, or anything that smacked of a big stick approach.
- The study report was distributed well in advance of the two surveys and did much to stimulate thinking on productivity. Participants' responses were very favorable regarding the usefulness of the study report and the value of the two surveys.

- The survey responses were completely candid. Although there was no requirement to sign their replies, all respondents preferred being identified. Professionals normally want to be identified for their ideas and opinions, and appreciate the opportunity to present them to senior management.

- Many managers, at their own initiative, used the study report as a basis for auditing their organization's productivity. Subsequently, they repeated this process using the 17 counterproductive factors as an audit checklist.

Looking Ahead

Hughes considers the results of its r & d productivity efforts as very worthwhile and encouraging. However, it is recognized that much more remains to be done. A follow-on productivity study is now in progress. In this follow-on study, the company hopes to expand its understanding of the subject and develop additional tools for improving productivity in the r & d work environment. In contrast to the original effort, which centered on productivity in the aerospace industry, the follow-on study focuses on productivity in commercially oriented r & d organizations.

As part of the follow-on study, interfaces have been established with 32 outside organizations and 15 prominent consultants.[3] The literature search and internal Hughes surveys have continued since the end of the original study, and will continue throughout the follow-on effort. Findings of the follow-on study will be combined with those of the original effort and summarized in a comprehensive second edition of "R & D Productivity," planned for publication in mid-1977.

Numerous organizations have become aware of the Hughes study. To date, more than 2,700 copies of the study report have been requested by outside organizations (70% industrial, 25% government/military, 5% educational institutions). A number of these organizations have subsequently inaugurated their own productivity improvement programs, signifying that a widespread concern for productivity exists and, more importantly, that positive action is being taken. Also, the report is being used as a management training text in some companies, and several universities have adopted it for use in courses and seminars.

The potential gains from increased productivity for any individual, organization, or nation are great. Unfortunately, too many are willing to give in to inertia of the day rather than take positive steps to improve productivity. Fundamentally, each of us has an inherent responsibility to apply, in the most effective manner possible, the resources with which we are endowed or entrusted. We must always seek a better way, rather than just leave well enough alone. Improved productivity requires commitment, ingenuity, action, and perserverence. The opportunity is there--what we do with it depends upon ourselves.

Sample Findings

On a valid definition of productivity: "Productivity can be defined as the ratio of valuable output to input, i.e., the efficiency and effectiveness with which resources--personnel, materials, machines, facilities, capital--are used to produce a valuable output."

On a viable approach to evaluating r & d productivity: "There are two basic approaches to evaluating productivity: (1) quantitative measurement, and (2) qualitative assessment. Highly structured, repetitive tasks tend to be suited for quantitative measurement. On the other hand, creative, abstract, non-repetitive tasks tend to be more suited to qualitative assessment...Inability to measure quantitatively should not cause concern; where quantitative measurement is not feasible, qualitative assessment offers a logical and viable alternative."

On the critical role of management: "The key to productivity improvement is management. Management's attitudes, actions, and personal example pervade the organization and directly affect employee attitudes, motivation, and actions... A positive management posture serves as an effective catalyst for productive activity...Only when management gives employees full attention will employees give management full attention. When employees feel their abilities are respected and that they will receive proper recognition for their efforts, they will normally perform effectively and measure up to the expectations of management... Generally, people will drive themselves if they (1) know what is expected, (2) think the effort is worthwhile, and (3) feel they will gain through effective performance."

On productivity leverage: "The overall productivity of an r & d organization is largely determined by the productivity of its management personnel and the top five percent of its key technical staff--people who deal largely in the realm of creative concepts, ideas, and judgment."

On organization structure: "A minimum number of management levels consistent with effective operations is conducive to high productivity...When organizational growth is warranted, it is usually more effective to expand in a horizontal mode."

On the impact of effective planning: "Ineffective planning causes major drains on productivity--people not knowing what is expected, tasks proceeding out of phase with each other, peripheral activities overproducing or underproducing."

On competency level: "If key positions are filled by competent people, other competent people will be drawn to the organization. If, however, second-rate people are selected for the key roles, they usually attract third-rate or fourth-rate people to positions below them."

On optimal staffing level: "The optimal staffing level appears to be 90 percent of apparent needs; individual output seems to drop off both above and below this level."

On misemployment: "Success in staffing means not only hiring capable people, but providing an effective match between individuals and their work assignments...A key and frequently overlooked factor in low productivity is misemployment."

On unnecessary functions/personnel: "Unnecessary/parasitic functions and low producers not only create a direct drag on productivity, but they are demotivating to people who are conscientiously trying to produce in the mainstream of operations...Deadwood should be pruned out of an organization from the top down, since if top management tolerates deadwood, all levels will."

On the correlation of individual productivity with personal attributes: "Personal productivity does not seem to correlate significantly with I.Q., creative ability, excellence of education or grades, courses taken since graduation, number of patents received, or number of papers written. While these factors are significant indicators of other important job-related qualities, they do not themselves appear to indicate a person's level of productivity."

On technological obsolescence of personnel: "Lack of basic ability seems to be a minor factor in the process of technological obsolescence; conversely, lack of stimulation/challenge/motivation appears to be the major factor... Although older employees are more likely to become technologically obsolete, no consistent correlation was found between age and technological obsolescence. Many scientists and engineers maintain creative output and high performance until age 65 and beyond, and are considerably more productive than their younger counterparts."

On the correlation of productivity with compensation: "Company gains from increased productivity should be shared with employees who helped bring about the increases...There should be a wide spread of salaries, with producers rewarded at the expense of nonproducers."

Profile of a Productive Organization

Organizations as well as individuals should be evaluated for productivity. And the study revealed that managers responsible for r & d organizations use--formally or informally--indicators similar to those used in identifying productive individuals. The most commonly used indicators focus on the basic characteristics identified below. Typical observations follow each characteristic.

The organization is effectively staffed and is people oriented. Without these qualities it has virtually no chance of achieving high productivity. Typical observations:

- Has effective and respected management/leadership
- Has outstanding personnel in key positions
- Has strong internal resources from which to draw
- Uses people to the best of their abilities--matches the assignment to the individual
- Provides the proper opportunities, assignments, and performance feedback necessary for personal growth
- Respects employees and their individual differences
- Is sensitive and responsive to employees' concerns
- Keeps employees informed
- Has an effective system of recognition and reward for achievement

The organization has high standards. A reputation for high technical and managerial ethics is the hallmark of a productive r & d organization. Typical observations:

- Has high standards of operations, and stresses personnel and product integrity
- Is performance/schedule/cost/quality/reliability-conscious; maintains high standards of achievement in these areas
- Maintains justice and equity in all operations
- Continually strives to improve operations

The organization operates in a sound, competitive manner. Prudent business operation and a readiness to perform and compete are necessary for productive enterprise. Typical observations:

- Has clearly established, worthwhile goals
- Is profitable--a strong business sense prevails
- Maintains a balanced capability which is sufficiently broad in scope to assure stability
- Meets it goals/commitments--consistently gives timely responses--can be counted on
- Is totally committed
- Lives within budgets
- Keeps costs under control
- Requires accountability
- Maintains a sound business backlog
- Affords reasonable organizational growth or at least relative stability
- Responds quickly and effectively to emergencies

The organization has a creative and productive atmosphere. In the r & d environment, factors that are conducive to creativity also tend to stimulate productivity. Typical observations:

- Is dynamic, flexible, adaptive, and free of stifling controls
- Encourages innovation and the taking of calculated risks
- Furnishes a continual flow of meaningful and challenging assignments
- Maintains effective communication among colleagues
- Provides up-to-date technological aids, equipment, and facilities

The organization has a "can do" attitude and a high esprit de corps. The enthusiasm, dedication, and teamwork of the people in an organization can never be underestimated as key factors in achieving optimal productivity. Typical observations:

- Employees exhibit a genuine sense of commitment and a determination to perform.
- Employees have a stong team spirit--they enjoy their jobs and are proud of their contribution to the team.

- Team members depend on each other rather than compete with each other--they exhibit strong interpersonal trust.

- Employees have confidence that management fully supports them and their efforts.

- The organization exhibits mature confidence in the face of difficult situations--does not panic.

- Employees have strong organizational loyalty.

NOTES

1. Original productivity study participants: Air Force Systems Command, Army Electronics Command, Bell Laboratories, Boeing Aerospace Co., Eastman Kodak Co., Goddard Space Flight Center, Harvard University, Hughes Aircraft Co., LTV Aerospace Corp., Lockheed Missiles & Space Co., Massachusetts Institute of Technology, Miramar Naval Air Station, Motorola, Inc., National Bureau of Standards, Naval Electronics Laboratory Center, Northwestern University, Philco-Ford Corp., Rand Corp., Rockwell International, Stanford Research Institute, Stanford University, TRW, Inc., University of California-Los Angeles, University of Michigan, University of Pennsylvania, University of Southern California, Xerox Corp.

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3. Follow-on productivity study participants: Air Force Flight Dynamics Laboratory, Air Force Rocket Propulsion Laboratory, Aluminum Company of America, Army Missile Command, Bethlehem Steel Corp., Burroughs Corp., California Institute of Technology, Celanese Corp., Chrysler Corp., Collins Radio Group (Rockwell), Cornell University, Corning Glass Works, Dow Chemical Co., E.I. du Pont de Nemours and Co., Exxon Corp., Federal Aviation Administration, Fiber Industries, Inc., Firestone Tire and Rubber Co., General Motors Corp., Goodyear Tire and Rubber Co., Hughes Aircraft Co., Merck and Co., Inc., Minnesota Mining and Manufacturing Co., National Science Foundation, Naval Air Systems Command, New York University, Princeton University, RCA Corp., Sperry Rand Corp., Texaco, Inc., United States Steel Corp., United Technologies Corp., University of Minnesota.

4. Portions of this article are extracted from "R & D Productivity--A Key Issue" by R.M. Ranftl, published in Astronautics & Aeronautics, June 1976.

Session 2

THE NORM OF (RESEARCH) PRODUCTIVITY VERSUS THE SPIRIT OF INQUIRY

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I want to comment on two notions I have about progress in a research project. The first concerns two conflicting views of research progress. The second has to do with the composition of the research team in this adversary climate.

So that you will know and I will be reminded of some of the many limitations to my thesis, I will say a little about my research experience. I have been actively, almost exclusively, involved in educational research for the past six years. All this time has been spent at the Center for Educational Policy and Management at the University of Oregon. The whole of my research experience during this time has been supported by the National Institute of Education. I am limited also in that I have not done much work in development or evaluation. However, during this period I have been a member of at least four research projects and have served as director of one project which has lasted for five years. I serve on various committees that develop or implement research policies in the center and the university.

The title of my paper--the norm of research productivity versus the spirit of inquiry--reflects the two dominant, antithetical ways that different people think about progress in research. One of these is a rational, investment perspective. It is observed in the language and actions of those who control, manage or account for research funds. I call it the norm of research productivity.

The Norm of Research Productivity

Where the norm of research productivity is strong, one can observe a number of pronounced tendencies. Foremost among these is the urgent desire to see that the financial investment in a research project is matched by the popular acclaim the research products will receive. Accordingly, the investor often determines what the products will be before selecting a research team. The research budget is set in advance, and nearly every expense is figured in terms of product costs. Products are supposed to be delivered on a time schedule so the investor can see that the work is proceeding in an orderly fashion. Finally, the investor frequently inspects the research project to see that proper scientific and budgetary procedures are followed.

The norm of productivity is strong and pervasive. The rational investment approach described above is part of our language and our cultural traditions. The norm is applied almost everywhere and few organizations, except perhaps churches or prisons, are exempt.

The norm of productivity has been improperly applied to educational research. I say this even though the norm is openly embraced by many educational researchers. In order to work, researchers often must obtain funds by showing allegience to the norm. In gaining a contract, they often make commitments which cannot be fulfilled and agree to employ techniques that are unsuited to the investigation. Those who fail to honor the norm of research productivity diminish their chances of obtaining research funds when they compete with others who adhere to the norm.

The Spirit of Inquiry

The norm of productivity is antithetical to the critical ingredient of worthy research. The norm of productivity drives the spirit of inquiry out of the research undertaking. Where the norm of research productivity is predominant, the term "spirit of inquiry" is regarded as a euphemism for waste, inefficiency, and skulduggery. For in truth, where the spirit of inquiry reigns, research is not the neat, orderly, and timely process that warms the heart of the investor. Edifying research has more in common with creative endeavors than with manufacturing. A research undertaking is typically full of uncertainties and ambiguities to which standard textbook solutions rarely seem applicable. The spirit of inquiry encourages one to seek out and come to grips with the imperfections in existing knowledge. We rarely find one best, clear-cut way to resolve these puzzlements. The spirit of inquiry is the essential companion of every worthy research undertaking. It must not be cast out by the norm of research productivity.

The spirit of inquiry characterizes the opposing view of research progress. It is marked by an unrelenting, often unsystematic effort to disconfirm one's current understanding in the hope that a superior understanding will emerge. This trait can be observed in the behavior and attitudes of our most deserving researchers.

Researchers recognize and appreciate progress. However, to researchers progress is not productivity in the investment sense. Progress does not mean fulfilling the specifications of someone's order for a prearranged product. Progress does not mean popular acclaim for one's own products. Acclaim, if it comes, is an unexpected side-benefit of research--not its goal. Progress does not entail strict adherence to a predetermined, often arbitrary, and usually incorrect research schedule.

To researchers progress means accomplishing various difficult technical tasks. These include identifying an area of inquiry that can be brought to satisfactory completion, and defining research concepts; a monumentally underrated and misunderstood task. Progress means fashioning an intelligent research design and implementing that design both flexibly and reliably. Progress means collecting, processing, storing, and retrieving data. Progress means making sense out of one's observations, and being able to explain to others the knowledge that was discovered and how it was revealed. Progress also means experiencing growth in one's technical competence and ability to handle larger areas of responsibility. It means sensing the same growth in one's colleagues. Under the norm of research productivity, these accomplishments enjoy only low regard.

Where the spirit of inquiry exists new knowledge is announced with cognizance of the precarious basis upon which it rests. Where the norm of research productivity prevails the basis of new knowlege is not thought weak unless the research products fail to return sufficient popular acclaim.

Composition of the Research Team

Faced with a strong norm of productivity, the spirit of inquiry is not sufficient by itself to guarantee research progress. In this regard the composition of the research team is an important element. In my experience, the most successful research teams were composed of a mixture of esteemed senior personnel who embodied the spirit of inquiry and rather bright junior colleagues, who held their senior teammates in high regard. The least successful teams were composed exclusively either of junior personnel or dominated by persons who conducted themselves solely to please or outwit their investors.

I have often wondered about these observations. I think the explanation is as follows. A spirit of inquiry leads to considerable debate, uncertainty and indecision. Some of the most difficult barriers to research progress are the inabilities to resolve debates, to proceed under conditions of uncertainty, and to know how and when to reach a decision. Where the norm of productivity was strong, these barriers were insurmountable. However, senior colleagues who have the respect of their teammates and who approach difficult issues to find their lessons can move over these barriers. Junior colleagues who find intellectual excitement in each new step can proceed with confidence in the direction advised by the senior team members.

Such a team is unlikely to make false promises either about its research products or the time and rate at which they will be produced. Such a team is likely to enjoy at least the illusion of investor confidence. Institutional managers are less likely to confront serious scholars with petty complaints. Investors are unlikely to treat respected figures as if they were students in their first research course. Such a team is also better able to identify and balance the conflicting demands of the norm of productivity and the spirit of inquiry. Such a team is better able to recognize when and to justify why a manager's recommendation should be ignored. Finally, such a team is less sensitive to the manifold criticisms it receives for not fully honoring the norm of research productivity.

Conclusion

I am aware that I may have exaggerated the distinctions between the spirit of inquiry and the norm of productivity somewhat. I am also aware that I have described an old and familiar debate. I make no apologies for these indulgences. I think it is important to remind ourselves, investors and researchers alike, that we sacrifice the spirit of inquiry when we are over-committed to the norm of research productivity. We cherish the heroes of science who maintained a spirit of inquiry against great odds. Let us maintain the spirit of inquiry in our own time.

The theme of this conference might be restated, "How does one get researchers to produce more products of higher quality?" I think this is the wrong question, for it implies that researchers are doing someone else's work. Neither productivity, in the investment sense, nor progress, in the research sense, will be high under the conditions. Serious scholars do not suffer long the inanities of the norm of research productivity. They often are replaced by less competent personnel who adhere to the norm of productivity. Work as hard as they might and often do, lesser researchers rarely give us anything of merit. On the other hand, if competent people were allowed to exercise the spirit of inquiry fully, a conference such as this one would be inconceivable.

Postscript

Although this paper did not enjoy the benefits of formal review at the conference, it did evoke various sorts of useful criticism. Some participants suggested that the paper failed to distinguish adequately between educational research and educational development. The point seemed to be that the norm of productivity should apply to the latter, but not the former. Indeed, Virginia Thompson's paper expresses this point of view. Others reminded me that educational researchers often justify their work on the basis of its immediate utility for the school setting. In so doing, educational researchers evoke the control mechanisms that are used to manage educational development. My colleagues also pointed out that the spirit of inquiry lacks an eloquent spokesman and has no political currency. In reference to these criticisms Alexander Field's address relied on the assumption that research productivity should be evaluated in terms of its impact on schools. However, Leslie Salmon-Cox was able to show that educational research productivity might be evaluated more intrinsically.

I agree that the educational research, especially theory-based research, has often been promoted on its potential for solving practical problems. Hopefully this tendency is weaker than in times past. It has created an additional genre of practical problems that researchers cannot solve. I agree that educational research lacks an eloquent spokesman and political currency. I doubt that the times will produce either. However, I cannot accept the premise that the norm of productivity should surround all of educational development. Rather it is my observation that educational development also requires the spirit of inquiry. The norm of productivity might be appropriate in the latter stages of development where, I presume, the technology becomes highly crystallized. However, in the early stages of developmental work knowledge is often quite imperfect. Progress, rather than productivity, should be the dominant perspective. To the degree that development and research are linked, it is often not clear when a project has moved from one enterprise to the other. In my experience the norm of productivity has been responsible for the lack of progress in development as well as research projects.

Session 2

THE RESEARCHER-DEVELOPER DEFINES PRODUCTIVITY AND EFFECTIVENESS

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Quite often the terms research and development (r & d) are misunderstood and misused in the field of education. Much of the confusion tends to result from not having a clear understanding of the purpose of each term. It could be simply stated that the purpose of educational research activities is to attempt to obtain a better understanding of some phenomenon, while the purpose of educational development activities is to conceptualize, produce and test the viability of methods or strategies seeking to accomplish specific goals or objectives under certain conditions. Both educational research and development activities are usually undertaken to improve the quality and relevance of educational experiences. To help ensure that these activities play a significant role in enchancing educational experiences, it is necessary for their purposes to have clarity and be easily understood.

Productivity and effectiveness are among the necessary ingredients for successful educational research and development efforts. Those of us who are involved with and/or manage such efforts must maintain a constant awareness in our work of these two key ingredients. There are several factors which cause managers of educational r & d to (1) be concerned about, (2) work toward being accountable for, and (3) attempt to exercise a measure of control over, with respect to productivity and effectiveness. Some of these factors are characteristic of each of our educational r & d situations whereas others are unique only to certain individual situations.

Productivity and effectiveness are highly sought after elements in most social, economic, political, educational, and even religious endeavors. Productivity essentially refers to the power of some phenomenon to produce, or its productiveness. Effectiveness basically refers to the power of a phenomenon to produce an effect; a desired effect; being in operation; active; being impressive or its impressiveness. In order to ensure that these elements are an integral part of educational r & d in my work at SEDL, it requires a mustering of effort in several areas. Let me mention these briefly. There is no particular priority or ranking in the manner in which I discuss the procedures that I attempt to employ. I shall mention some which probably are familiar to each of your efforts involving educational r & d. And, I shall mention others which I consider to be particularly important to my work in helping to ensure productivity and effectiveness.

1. Planning the R & D Effort

Thorough planning should precede the implementation on r & d activities, continue throughout these activities and lead into the conduct of future activities. R & D planning needs to proceed from some general or overall concept, to the particular program/project area, to specific individual objectives

and tasks. This is necessary to help ensure productivity and effectiveness. Planning for r & d must be continuous and flexible enough to allow for alternative courses of action when necessary. Care must be taken to avoid concentrating the planning effort only on one area or phase of r & d activities. Each aspect should be fully addressed. Planning has to avoid the notion often espoused that "no research/development effort is a failure because you can learn something from it whether it is a failure or a success." This kind of approach frequently leads to haphazard r & d planning and activities. Thus, planning must include establishing clear goals, objectives, procedures, assessments, and desired outcomes in some logical and sequential order which can contribute to productivity and effectiveness in educational r & d.

2. Organizing the R & D Effort

Making the necessary preparations for r & d to be carried out involves clearly delineating the tasks and responsibilities. This includes identifying what is to be done, who is to do it, and what alternatives or contingencies are in case something falters or requires revision. Organization should be done according to the tasks to be accomplished rather than solely by position or title. A clear outline or schedule of deadlines and target dates should be in the hands of all involved, along with a system of reminders. In order for r & d to be truly productive and effective, no task should be too great or too small for those involved.

Varying the organizational structure, "switching up," can often provide a welcome change of pace for r & d staff. Shifts in emphasis and direction which are congruent with individual skills and interests often can stimulate new thinking where stagnation may have occurred. Thus, organizing for r & d should allow for variation in the deployment and utilization of staff capabilities to assist with productivity and effectiveness.

3. Implementing the R & D Effort

Actual carrying out of the r & d effort should be done as closely as possible according to the plan and organization for action. The manner in which tasks are initiated and completed will be determined by everyone's comprehension of what has to be accomplished. Special stress should be placed on the importance of each person's work and how successful completion of the r & d effort depends on the combined contribution of everyone.

Implementation of the r & d efforts can also be enhanced through providing staff with a variety of situations in which to work. A change of scenery could be most conducive to stimulating staffers to be more productive and effective. In addition to providing a variety of working situations, offering the opportunity to work or interact with a variety of people, when possible, could contribute to increased staff output. The point here is that work in r & d efforts should not be allowed to become dull routine. Implementation activities which offer some variation in how they are carried out could be critical to r & d productivity and effectiveness.

4. Monitoring the R & D Effort

Keeping track of r & d activities, once begun, is a very important factor which contributes to productivity and effectiveness. In the monitoring phase, several key aspects should be kept in mind. In this phase, monitoring must

(a) be continuous, i.e., daily, hourly (sometimes), etc.

(b) be obtrusive and unobtrusive

(c) be systematic and sometimes unwavering in format or focus

(d) be positive in approach so as not to alienate those involved in r & d effort

(e) be clear in purpose and reflect a direct relationship between these activities and the outcomes being sought

(f) make some allowance for "on the spot" analyses and decisions which help facilitate activity completion

(g) be conducted as close as possible to specified tasks, responsibilities, plan of action, schedule, due dates, etc.

5. Evaluating the R & D Effort

Evaluation of the r & d effort starts with its conception. Analysis and feedback should occur constantly throughout the duration of this effort. Every attempt should be made to recognize and deal with problems as soon as they arise. Assessment of the r & d effort should basically be done according to its goals, objectives, and expected outcomes. Both internal and external assessment is necessary.

All critiques and analyses of the r & d effort need to be concise. They should provide clear implications or directions for revisions where needed. Brief but precise narrative descriptions should be maintained concerning evaluation of the r & d process and its progress.

Specific Methods to Ensure Productivity and Effectiveness

These five facets of r & d efforts are in no way a complete description of what occurs in these kinds of endeavors. However, they generally represent what are important considerations when conducting r & d. As for specific methods that I employ to help ensure r & d productivity and effectiveness in my work at SEDL, the following discussion is offered.

First, I attempt to develop a sound knowledge base or background for the particular r & d effort being undertaken. This is critical to providing appropriate leadership and direction to staff when and where needed. I have found

that it is advantageous to the program's goals, and to me as a director, if staff can perceive you being as involved as they are in carrying out this effort. In addition, there is still the subtle pressure on and expectation of miniority r & d managers to know and do a little more. As r & d managers, minorities are still not readily accepted or respected. Thus, there has to be a constant push for acquiring more knowledge, even more than may be required normally.

Special attention is given to developing a knowledge base which represents what is known and reveals what new information is needed. The information assembled then comes from as broad a perspective as possible in order to guide the r & d effort.

Second, I insist on being provided with the needed details and documentation for r & d productivity and effectiveness. An attempt is made to employ a "perfectionist attitude" toward the work to be completed. Displaying this kind of attitude does not guarantee that perfection will be attained, but the objective is to instill motivation, to strive for the best r & d effort possible. Such an approach to r & d leads me to reject vague or ill-defined approaches, plans, implementation and evaluation of the r & d efforts.

Being knowledgeable about each step of the r & d process as it takes place and being involved with decisions for alternatives when necessary are critical to improving productivity and effectiveness. This requires holding staff accountable for their responsibilities as each phase of the r & d effort proceeds. Close examination and review of r & d products/strategies at every level in the process are critical to helping ensure r & d productivity and effectiveness.

Third, I attempt to transmit most of the feedback and encouragement to staff members through informal, individual interactions. When appropriate, though, I do praise staff efforts in small or large group settings. It is my belief that calling personal attention to accomplishments and areas of additional needs is an effective method of increasing productivity. During interaction with staff members, I almost always meet with them on their own "turf" (work area). My perception is that they feel more at ease, secure and important when I come to them.

Staff members are allowed to describe and analyze problem situations as often as possible and then take a major role in helping to resolve them. This is an effort to encourage and maintain cooperative problem solving rather than authoritative decision making. By keeping staff informed, to the extent possible, of external and internal decisions, actions, concerns, frustrations, achievements, etc., it is hoped that this will help them to understand and be more willing to positively contribute to r & d productivity and effectiveness.

Fourth and finally, I attempt to run an "open shop" in our r & d efforts. Being easily accessible to staff, listening to their programmatic concerns, acting, when possible, upon suggestions and recommendations, emphasizing the value of individual contributions to project success, revealing "who I am," "what I'm about" and what my expectations are, all represent most of the methods I employ to increase staff productivity and effectiveness. In addition, overt

attempts are made by me to avoid projecting the "all knowing" image. Instead, I participate as a learner along with being a leader. This also includes interacting with other SEDL colleagues to gain from and utilize where appropriate their r & d knowledge and skills.

The points that I have mentioned in the preceding discussion perhaps are not that new or revealing. Most of you have employed these and many others in an attempt to increase r & d productivity and effectiveness. Given that this is true, my reemphasis of these points, if for no other purpose, I hope has served as a reminder that there is a set of basic elements which tend to hold true when we speak of ensuring productivity and effectiveness in educational r & d. Thus, it is our collective efforts, the sharing of information from such efforts, and the efficient utilization of lessons learned from these efforts that can serve to assist all r & d managers to increase their productivity and effectiveness.

Session 2

PRODUCTIVITY ISSUES IN RESEARCH: THE PERSONAL PERSPECTIVE OF ONE RESEARCHER

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For each of us, our week has seven days; our day has 16 wakeful hours, more or less. It has always amazed me how some of us seem to accomplish so much more in that time than others of us do. Much of our differences, no doubt, are metabolic--my college roommate used to fly out of bed, pour on his clothes, inject his breakfast, and be in the midst of his differential equations before I had washed the sand from my eyes. (On the other hand, he fell into a stupor by 8 p.m., when I was finally picking up a full head of intellectual steam.)

Apart from metabolic factors, certainly many of our interpersonal differences in accomplishment are related to varying natural abilities, and differential values and motives. But what I would like to discuss today, from my perspective as an individual researcher employed in a research center setting, are certain incentives and constraints that may be imposed to assist individual researchers in their goal to be more productive, given their biological and ideological makeup. Some of these incentives and constraints are self-imposed by the individual researcher; some are structural factors, imposed by the research organization.

Every person operates with a personal set of problems that may impede productivity. To the extent that these problems are unique, solutions are generally best made individually; to the extent that they are commonly shared, it may be optimal for the work group to be structurally organized to promote their solution.

One problem may be, however, that a structural adaptation that may be advantageous for some members of an organization may lead to lower productivity by others. The leadership must then decide whether to modify the structural arrangement, change the employment pattern to phase out "negatively impacted" individuals, or, if possible, to "individualize" the treatment, adjusting the social structure to each person's style and needs.

The problems that most affect me as a researcher are three: the problem of extra-curricular demands on my time; the need for social support and immediate feedback regarding the worth of my product; and the problem of closure--the ability to see a task through to completion.

The first of these--the personal distractions issue--is one that may or may not be widely shared, but which does not really suggest an organizationally mandated solution. My family and intellectual and recreational pursuits are as much a part of me as my work. The strategy of segregating these pursuits in time and space from my research activities has become more and more obvious and necessary. Yet this solution admittedly does not maximize research productivity since it would always be possible to extend the hours devoted to research at the expense of satisfaction in other realms. But, to compromise these conflicting interests,

I have self-imposed a 9:00 to 5:30 five-day week--something I swore I would never do--placing only limited additional time demands on my evening and weekend hours.

The organizational role is much larger with respect to the other two problems I mentioned--the need for social support and objective feedback and the need for both pressure and freedom to complete a task. These factors are very much tied up with one another.

For most people, productive work requires a mixture of independence from supervision and from organized demands on one's time, on the one hand, and collegial and supervisory attention, criticism, and emotional support on the other. Too many obligations on one's time are distracting; too much supervision can be inefficient; and yet too much independence prevents early detection of errors and produces too many points where work is stymied by a particularly perplexing decision or by the need for an outsider's perspective. As Arthur Stinchcombe once commented, "The conviction of intrinsic value of work is a weak reed to sustain a year or two of drudgery."

One of the characteristics of social science research, particularly basic research, is that the market for our product depends on a long chain of actions beyond our individual control: peer review, dissemination, interpretation, and so on. We often lack immediate feedback on the overall direction of our activities, the quality of our assumptions, analytic technique, expository style, literature coverage, and so on.

It is not only a concern for objective feedback that motivates an interest in collegial and supervisory contact but ego support as well. For most people self-esteem needs to be frequently refueled. Sincerely expressed interest in what the researchers are doing, sympathy for their problems, and sincere praise for what they feel are breakthroughs they have made are bound to encourage further productive activity. This is particularly true if such support is expressed by someone held in high esteem. While this may be a colleague, it is probably more effective when expressed by a superior. I would maintain, as a result, that organizational leadership that provides frequent, even daily, positive feedback, even to a degreed and fully professional research staff, is likely to be effective in stimulating the productivity of its workers.

In a number of ways our center provides for the kind of feedback and support I am talking about. The center's director for the most part stays very much on top of what each researcher is doing. Helpful in this regard, I might note, is the placement of his office. Instead of being located at the rear of a well-protected outer office of secretaries and assistants, it is strategically located (with wide-open broad double doors as its entrance) at the immediate left of the main entrance to the center--and adjacent to the staff mail boxes as well. This location and openness encourages frequent communication and interaction between the director and the professional program personnel.

Accomplishing a task requires more than social support, of course. The stick is often as effective a tactic as the carrot. But there are gentle ways of constraining inefficiency. For many people, including myself, having a deadline is important. One reason deadlines are important is that our priorities

tend to be reallocated in the direction of scheduled activities, regardless of their intrinsic importance. Appointments, classes to teach, eating, and going home to family all seem to take precedence over getting research done, when deadlines are absent.

Deadlines, however, are useful mainly when supported by expectations of others: conference session chairpersons or government civil servants, for example. For its part, the work setting may impose deadlines in a useful and nonarbitrary way. Weekly lunchtime seminars which give coworkers an opportunity to learn about work they may not be personally involved in also provide a goal to be ignored only at the risk of shame for a poor performance.

Giving social support to colleagues and attending seminar presentations may be advantageous to the recipient of this attention, but they also constitute potentially nonproductive demands on the time of the attention-giver. One roadblock to project completion is the proliferation of such demands on one's time. Reviewing one's priorities frequently, and then imposing deadlines based on those priorities, will help a person decline many of these external demands. If you have determined that completing chapter one is of high priority, and fixed it on your agenda for the day, it is easier to say no to other demands on your time.

Another interference with a well-planned schedule is the demands of your own assistants. It is easy to fall into the trap of adjusting your priorities in order to meet the appetites of secretaries and research assistants for additional work. On the one hand, these appetites demand that the researcher make some measurable progress--that the code book be completed so that the secretary can have something to type--but often the question of what to do next is decided on the basis of which assistant is most in need of work, rather than which task is most important to be accomplished. At our center, the organization of support systems helps solve this perennial problem. While specific research assistants and student aides tend to be allocated to individual researchers (and they are generally recruited on an individual basis), the services of the secretarial staff and the computer programming specialists are shared by all professionals, with priorities pretty much based on need.

There are, of course, other variables involved in the task completion problem besides social support, feedback, freedom from interference, imposing deadlines, and keeping priorities straight.

One factor in raising the probability of product completion was suggested by Stinchcombe--having several projects on the fire at once. It is inevitable that any given project will reach an occasional rut. If one's activities are totally engaged by that project, such a derailment may make one reflect on one's ability to get anything accomplished (or as Stinchcombe suggests, one's entire "identity" may be held responsible). By being able to turn to other activities and make progress in other directions, the problem on the first project remains less generalized and the attack on it remains more focused.

Another incentive is to be assured that there will be <u>some</u> product at the end of the tunnel. One way of accomplishing this is for the organization to produce and externally disseminate a publication series of articles and reports by staff members. Such a publication series has the additional advantage of

providing the potential for broader feedback regarding research ideas and findings beyond the formative stage but prior to submission to professional journals. While not formally refereed, papers submitted through such a series will have gone through a certain degree of review and comment from colleagues within the organization. At our center, in addition, the articles submitted are reviewed by an editorial specialist.

For the most part, I have been discussing productivity with respect to the task accomplishment problem--how to get a given product completed once the decision has been made to produce it. Probably more important to overall productivity, however, is the issue of task selection--the choice of which products to produce.

Questions about task selection are primarily of concern to the managers of r & d settings. But individual researchers see these issues as relevant to their own productivity as well. While researchers generally appreciate guidance and social support in their activities, I would maintain that, if the recruitment task has been properly accomplished, the researchers hired should be capable of being responsible for their own selection of research problems within the broad framework of the goals of the research center.

Peter Rossi, in a recent article in Educational Researcher, suggested that the optimum leadership style within an r & d center was not "discipleship," but the "institutional person." This is a rather decentralized style that tolerates diversity in the style and content of research activities; where the leadership derives personal satisfaction from the independent accomplishments of others which bring rewards to the institution and not personally to the leadership.

On the other hand, Rossi suggested that a consortium of independent research entrepreneurs is probably not as productive in the long run as a place where the leadership is able to exert rather persuasive influence over the direction of research activities.

The solution here, it seems to me, lies in a blending of these leadership styles. There should be a commitment and even an expectation that researchers develop their own specific research plans, consistent both with their own intrinsic disciplinary interests and with the overall organizational direction. At the same time, the leadership would be responsible to assure that such research ideas, through collegial assistance and support, be elaborated into refined, potentially productive research proposals.

There are, of course, many other aspects of the productivitiy issue. There are definitional problems such as whose standards of productivity our efforts should be directed towards: the funding agent's interest in project completion, regardless of value; or the researcher's own immediate valuations of the relative worth of different efforts, regardless of his or her prior perceptions and prior commitments to complete projects.

Also, there are managerial issues such as whether it is best to invest manpower in data collection activities which tend to be highly episodic and

demanding of time and effort; or whether to entrust these activities, which nevertheless require extreme attention to detail, to an external organization that may be insufficiently motivated to provide the careful oversight required.

But these latter are primarily problems of managers of research facilities. I have instead focused my comments on those most relevant to my own activities, as a professional sociologist employed in a group research setting.

Session 2

A DEVELOPER'S LOOK AT EDUCATIONAL PRODUCTIVITY AND EFFECTIVENESS

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A "National Conference on Productivity and Effectiveness in Educational R & D" is impressive! My first reaction to the title was, "Will the conference be productive and effective, and if so, how?" My anxieties were relieved some when I learned that presenters would include not only those of us from educational r & d but also individuals from the business sector of r & d. It isn't that educators talking to educators will not be productive or effective, but I do think sometimes, through lack of a profit incentive, educators are not as conscious as we should be of "making the most of the buck" in our research and development work.

Another reaction I had to our conference title was fear that the terms might lack universal definitions, which is always a good way to tie up discussion. By the time the terms are defined, we're left with no time to discuss issues. Webster's gives us some common definitions of what it means to be "productive": having the quality or power of producing, especially in abundance; effective in bringing about; yielding or furnishing results, benefits or profits; yielding or devoted to the satisfaction of wants. Productivity in my life span has had many meanings and measures:

- When I was a teenager in the strawberry field, it was defined as the number of hallocks that constituted a crate and for which I was paid $.08 per pound.
- As a beginning secretary assigned to type stencils (in those days high speed copiers were unheard of), it meant the number of stencils completed in a day.
- As a grocery clerk, productivity was measured by the total amount of sales on the cash register at the end of the day.
- As a keypunch operator at a large Portland bank, it was an hourly item count on which pay raises depended, determined by the number of cards punched each hour--minus two for error made.
- There was even a time when my productivity was judged by the number of children I had.

Effectiveness, by definition, implies proven capability based on productiveness in operation and especially stresses ability to perform well and economically.

Inherent in such performances are the absence of wasted time, energy or material; the demonstration of skillful management of means; and technical expertness suggested by the term "know how."

With a work-ethic, production-oriented background, I journeyed from teaching into the hallowed r & d community determined to make the federal dollar invested in our project pay off in terms of usefulness to local educators in every possible way. This motivation wasn't entirely my own; it was conditioned in part by the feelings of my fellow teachers that somehow educational r & d was a dollar waster, seldom yielding practical results for the field.

For the purposes of this discussion today, I am a developer. Based on my experience at the laboratory in that role, I feel there are some critical elements necessary to ensuring productivity and effectiveness in r & d.

I believe there are some personal characteristics necessary to being productive and effective as an educational developer. First you have to believe in what you're involved in. It takes creative energy, enthusiasm, excitement and belief that the impossible just might work. On the other hand, it also requires a willingness to have your theories, concepts, and creative work laid bare to the cold scrutiny of evaluators who might find the project or program to be ineffective, producing results just the opposite of those hypothesized and sent back to the mental drawing boards for replanning. Developers have also been described as individuals who are intuitive, artistic and craftsman-like in their work. Educational r & d, I believe, requires an adaptive, resilient, risk-taking individual, one who is as open to scrutiny as the stencil typist or the strawberry picker.

Insofar as it is possible, I am of the opinion that programs should be functional while going through developmental and evaluation cycles. Some programs are developed in a theorist's study, put out in the world for a test--while hoping for high fidelity, evaluated and then pulled back to the study for revisions. I believe that the "hot house" development of programs should be as short as possible with operation occurring during final development. Ongoing cycles of development, evaluation, redesign and further development, and refinement ensure that the investment will have pay-off more rapidly than if the development happens in an isolated theory environment for an extended period of time. This process of development and operation is risk taking and demands hard, honest scrutiny of effectiveness, including successes and failures. It requires backing off from pet theories (often in public view) in the light of proof that a concept doesn't work and acceptance of evaluation findings that a different strategy is needed. But for my money, this is one way to ensure effectiveness.

It goes without saying, I suppose, that field-based development is often more messy and time consuming. But, according to the Rand study, the study of NDN and others, it appears to be about the only way to ensure effectiveness. An issue which needs to be raised also is the necessity for educational development to seek a balance between productivity and effectiveness. Some observations show that frequently, when development extends over a long period of time, the program actually goes through radical shifts and that, at a point in time, developers have to determine the product, under development conditions, is finished.

There always is the possibility that once pilot tests are begun and marketability examined, changes will occur. But there is a need to strive to balance productivity with effectiveness.

A developed project, program or product should be moved from the demonstration test site to pilot site in as short a time frame as possible. The use of a limited number of pilot sites to test the program in new environments assures that the dollar investment will have benefit for more schools and more students. It tests the stability of theories in new environments and, when successful, creates needed advocates for your product. If developers wait too long to begin moving a product out, the world loses interest. Also, if it appears that the results of the r & d efforts will never be available to other users, an atmosphere of hostility and mistrust can even develop.

R & D projects and programs should recognize, plan, and staff for changing program emphasis, or what I call the developmental cycle. During different phases of this cycle, different kinds of expertise can "save" the program and help it to the next cycle. These phases are:

- The development phase itself: At this time you have creative developers, seasoned practitioners, creating and beginning to implement your design. They are the risk takers, the "we can conquer the world" troops. There needs to be a word of caution here. Too often we make our development too people dependent. That is, the developers build themselves into the product so tightly that we cannot effectively diffuse without those people.

- During the total cycle, but especially within a year or year and a half, your project will need the systematic, critical, strong evaluation perspective. The results of these evaluations must be realistically and honestly reported--for both internal changes and external audits. A good evaluation team can, many times, save a program for further funding and brighter futures.

- Somewhere in the second year of operation it becomes critical to gather together and synthesize materials and document how a program or project works. At first it may not be clear or you may not have an agreement on what will be done with this material, but it is critical that the program and its development be described, I believe, while some of the original developers are around. It is equally important to document, for future users, what didn't work and why--as it is to report what worked and how.

- Lastly, it is critical to plan for the spread of information and procedures for transferring the capability to install a program. And this is where the cycle of training and technical assistance becomes important. This cycle must be well planned and occur early in the development cycle to insure the greatest spread and availability for the least amount of money.

Given that I believe there is a developmental cycle, I believe that good management of educational r & d should make maximum use of personnel in these various cycles. For example, an individual who has been part of the developmental team can, through training new staff to assume their roles in the program, help develop training materials for handbooks and program installation. Once the program is operational, that developer might then become a trainer of staff for new programs. Likewise, an individual who has been heavily involved in documentation of the project might become an effective trainer--taking with him/herself an entirely different perspective because of a rather analytical look at the program or project.

Educational r & d programs should be made available to as broad an audience as possible through as many avenues as possible. Some developers have such a personal vested interest in their project that they are reluctant to let it go for fear that it will be either misused or used inappropriately. To me the reverse is true. If I believe strongly enough in the program or project and its potential for school improvement then I also believe that the ways adopters or adapters choose to use it will also be beneficial to them, perhaps not in the way I had originally intended, but maybe even in a better and more productive way. Spread of an innovation should occur in a multitude of ways:

- Making potential users aware of the product or program through brochures, multi-media presentations, articles, word of mouth.

- Taking appropriate parts of a program and packaging them for use in classroom or local educational settings with no training or technical assistance required.

- Providing short-term training sessions in some of the core aspects of a program.

- Producing step-by-step handbooks which allow potential adopters/adapters to take the developed program and implement it in their own setting with no training or technical assistance--if that is the way they choose to proceed.

- Designing and providing training to install a total program on as cost-effective a basis as possible.

- Taking a developed program or project one step further by suggesting creative ways strategies developed in a program can be adapted and used to meet different needs. My opinion is that whole model spread alone is nonproductive and frequently ineffective.

If they believe in their program or project, developers ought to operate on the assumption that the current year is the last year of funding (and well it might be). If they believe strongly enough in their own program and its potential effectiveness as an agent of change, they will want the program to last over time--whether the funding does or not. With this kind of pressure, there is often an urgency to get products out, to get people trained, to build support networks and to get new materials developed so that the program is lasting.

My experience with this type of urgency is that it forces developers to be creative, productive and strive for an effectiveness that is characterized by little wasted time, energy, or materials. And that in itself demonstrates skillful management of means and technical expertise.

For those of you in executive positions, I believe it is imperative for developers in labs and centers to have a sense of the mission of your organization. Our mission is:

- developing and disseminating effective educational products
- conducting research on educational problems
- providing technical assistance in educational problem solving
- evaluating effectiveness of educational programs and projects
- providing training in educational planning, management and instruction
- serving as an information resource on effective educational programs and processes.

Good management encourages study on a continuous basis of development processes and theory. Sometimes even impatience may also be a necessary executive and management trait--to constantly ask, "can we achieve the same or better quality in a shorter period of time?" Frequently, under the federal funding arrangements, there is little incentive for speed--rather the incentives to be slow and expensive are high. There is frequently no bonus for finishing early. Management also has to be aware of the amount of time developers have to spend in writing reports, proposals, and meeting their federal demands. From my experience, there are individuals in executive and management positions who allow--no, who encourage developers to be responsibe to clients in their region; to be creative in the development of programs and projects; and to be productive and effective in the execution of their work. We, as developers, can ask no more of others. What I focus on today is what we must ask--require of ourselves.

Session 3

MANAGING R & D FOR INCREASED PRODUCTIVITY AND CREATIVITY

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The most valuable resouce available to any organized group, whether it be society, a company, or an institution, is the skill, intelligence, and productivity of the individual. This has been aptly termed "human resources." The principal role or concern of management, then, is to realize the full potential of each individual to produce, innovate, and create in a manner that will increase overall productivity, profit, or contribution to objectives. Although we are concerned primarily with research and development, and thus, with scientists and technologists, the author believes that the successful management of all people involves the same principles.

An appropriate "management theme" or operational context can be identified by examing history. Since history documents the results of organized humans' efforts under a variety of circumstances, it must also tell us what context may be appropriate for a group of researchers. Consider the following:

1. Toynbee's study of history concludes that societies rise and fall on whether or not they rise to meet external challenges.

2. One of Western man's most creative milestones was the Renaissance. It is believed that this resulted from the competition and conflicts between the Italian states of that period.

3. Popular wars have historically been periods of inventiveness and productivity.

The fact that the "human dimension" is important to productivity in r & d is apparent. Economic studies of the impact of research and development on corporate profits and growth show that correlations of r & d expenditures versus size and growth, r & d dollars versus net profits, and size of research groups versus their contribution to new products, are inconsistent. Some companies are more successful than others, and some groups are more productive than others. Such studies, by their very nature, must eliminate or reduce to a minimum the human part of the equation. Is it not possible, then, that in "the more successful cases," management has been more effective in establishing a more creative and stimulating environment?

Based on some understanding of history and personal observation by the author, this discussion presents a general management theme or context and some elements in its implementation.

Basic Management Theme or Context

Following the example of historical "success" and the natural responses of Western man, the basic management context for increased productivity and creativity in r & d consists of: (1) challenge, (2) response, and (3) reward.

Outstanding management, then, involves initiating and closing this cycle of events. Unfortunately, the many factors involved in this cycle complicate it beyond the simple expression given. Since we are dealing with people, building and sustaining it becomes an art. Operating within specific, narrowly defined rules does not work because people differ.

Challenge is the first step management should take to create an atmosphere favorable to productivity/creativity. The challenge should be transmitted to all members of the organization and in different forms since people and their functions within the organization vary. For some individuals the challenge comes from within. Creativity should be considered in relation to not only scientific activities, but also sales, administration, and services, all of which are functions of an organized group. Thus, we are challenging the staff to innovate, suggest changes, create new products, and develop new technology--all aimed at improving the output of the organized effort. This is a continuous activity that takes time and effort.

Definition of the challenge is, perhaps, one of the most difficult parts of the creative process. In most cases in today's complex technology, problem definition and/or challenge formulation requires the combined thinking of a number of researchers versed in different disciplines. Management can help to initiate and guide the creative process by implementing the below-characterized approach:

1. Indoctrinating the staff with a reasonable understanding of the organization's objectives and how the people might contribute to them.

2. Presenting challenges to the entire staff.

3. Communicating the problems and/or challenges clearly enough to minimize confusion of the individual.

4. Characterizing the challenge, whenever possible, in the form of a task and/or a goal or purpose, with appropriate freedom to act and authority to implement.

5. Creating an environment in which researchers can communicate and work with their counterparts in different parts of the organization without impedance from management.

6. Providing frequent changes of challenges and new tasks rather than permitting sustained activity on one project.

All of these factors relating to challenge can be effected by management. It is apparent that initiation of challenge requires management's strong participation as well as action to provide freedom and tools. These, in turn, will permit the staff to respond effectively.

The response to challenge will come from individuals or groups. This is what management is striving for, and it must handle this portion of the cycle with the same diligence as was used in initiating the challenge. The individual will expect the following from management:

1. A reception of his/her ideas regardless of past performance or current position may be.

2. An opportunity to try out suggestions within the resources available.

3. An open mind to unorthodox ideas.

4. Consideration of his/her ideas regardless of differences in personalities.

5. Help and guidance in obtaining services, equipment, or talent that will enhance the suggestions.

6. Freedom to respond in keeping with his/her individuality.

Freedom to respond to a challenge probably deserves special analysis and discussion in today's environment. Consider the following:

1. Over a 25-year period the average weight of the research proposal documents submitted to the federal government has increased by a factor of 10 to meet bureaucratic regulations.

2. Confusion in regulations or policies carries over into many actions today, rather than permitting confident action.

3. The "system" does not always reward those who respond to a challenge with positive action, but rather rewards those who make "no mistakes."

Reward is the most difficult part of the challenge-response-reward cycle for management to implement. A psychologist recently said, "If we just knew what kind of reward each new employee really wanted and we could provide it, we would double the creative performance of our staff." The fact is: different people want different things, money being perhaps the most common denominator since it can be converted into means for satisfying a variety of specific desires. Some individuals, for example, want only a certain environment. Enthusiasm is generated when the individual knows that the results of his/her efforts (innovation, new concepts, creativity) are going to be implemented. However, consider the common complaint of scientists and engineers working in the laboratory: "My boss is not interested in science." Whether the boss is or is not really interested is a good question. Unfortunately, if this is indeed so, the boss has inhibited creativity.

Reward is the prime motivation of people, and it must be implemented fairly and consistently. Yet the specific nature of the reward given to different people must be different; management must be flexible. Thus, it follows that:

1. Response to a challenge must be recognized and rewarded by management.

2. Reward must be real and in keeping with the challenge and the response. It is easy to succumb to rewarding "old Joe" for faithful service while outstanding performance by a younger person is disregarded.

3. The nature of the rewards available should not reduce technical or scientific creativity. For example, management's demonstration that administrative positions are more desirable than technical ones may stifle technical creativity.

4. A variety of rewards must be available; publicity, financial reward, position, authority, recognition, stature, and working freedom.

The basic needs for an atmosphere that will maximize the creative talents of individuals or groups can be seen in the characteristics of the creative individual. Interestingly, these characteristics align themselves generally with the categories of challenge, response, and reward:

1.	Is intellectually curious	Challenge
2.	Enjoys a changing spectrum of activities	
3.	Defines problems	
4.	Is strongly motivated	
5.	Puts data together in different ways	
6.	Is goal oriented	Response
7.	Is not afraid of new ideas	
8.	Seeks recognition	Reward
9.	Wants to see his/her contributions implemented	

Management's role is to establish the proper environment or climate. To be successful, management should use the factors discussed above to orient its policies, decisions, and actions. These policies and actions must stimulate and not restrain creative expression. And, indeed, strong action is required to initiate and maintain freedom of action and expression.

An example of a major dislocation to the challenge-response-reward cycle is the following. A well-known government laboratory has a mission to develop through r & d increased practical use of a basic commodity--this is the challenge. Advancement and other rewards for the individual are based solely on the number of basic research papers published by the individual. However, while outstanding basic research is done by this laboratory, the contribution of such research to the achievement of the laboratory's mission is nominal.

How Management Can Meet These Needs

Management's problem is to direct the operation of the r & d effort so as to optimize the creative benefits of the challenge-response-reward cycle. This requires:

1. A real desire
2. Real reward mechanisms
3. Creation and maintenance of a stimulating environment

Desire on the part of management to maximize the creative potential of a company's staff is not to be dismissed lightly. One might say, "Why certainly management wants to improve the creativeness of the staff," but doing so is not easy. It involves making difficult decisions, as well as an ability to resist pressures of a social, political, and personal nature. Rationalization of success or failure of individuals must be minimized. Does this sound like a simple task? Add to this one fact: that in general, no leaders or organization take energetic action to promote increased creativity/productivity. Even so, this is probably the most critical step management must take. Its dedication to this goal will manifest itself to the staff both overtly and covertly--and both kinds of messages are picked up by the staff. Answers to a few questions illustrate how management communicates its desire to enhance creativity:

1. Does management visit the laboratories?

2. Does management seek the opinions of scientific personnel?

3. What proportion of a manager's time is devoted to talking to technical people?

4. What are the relative conditions of the laboratory working areas compared to management's?

Reward, in one form or another, is the action taken by management to complete the challenge-response-reward cycle. Because people differ, seek different things, and contribute to the organization in different ways, reward must take different forms. The first step in creating a reward process that will maximize creativity/productivity is to build it into the basis for advancement. Thus, the individual will immediately recognize that this is desired by management and will do something about it. The basis for advancement should be simple, clear, and consistent in its use. A suggested basis would be: performance on assigned tasks; and performance in suggesting and/or initiating new scientific and technical concepts and programs or operational activities aimed at achieving the organization's mission.

This basis for evaluating and advancing people is one of the keys to what management can do to maximize the potential for performing outstanding r & d. It is as applicable to a clerk as to a solid-state physicist. It clearly indicates that management expects and is looking for initiative, creativity, and productivity from the research staff.

This suggested basis for advancement within the organization has two additional benefits: First, its simplicity should minimize distortion of its message

by the communication network in the organization; second, its expression of a desire for creativity/productivity signals reward for those individuals who are creative.

To properly implement this basis for advancement is not easy. It involves evaluating the response of individuals and rewarding individuals with different desires. The most appropriate solution to the latter problem is to reward people on the basis of their functional accomplishments within the organization, this probably being the area where they wish recognition or at least where the reward will make sense to the individual, to his/her colleagues, and to the staff generally. Every organized group of researchers consists of those people who provide services, those who perform administrative or management functions, those who are concerned with marketing and sales, as well as those who perform purely scientific and engineering tasks. Cannot an individual who demonstrates creativity, initiative, and accomplishment in any of those areas be rewarded? It must be real reward for real accomplishment--no rationalization about "good old Joe." The seriousness with which management implements reward can be indicated by the answers to the following:

1. Are there real positions in the organization for individuals who demonstrate scientific accomplishment?

2. Are the "scientific positions" occupied by individuals who are creative and have initiated new concepts, or are they occupied by persons whom management didn't know what to do with?

3. Is the reward for outstanding scientific performance the advancement to an administrative job?

4. Do people who perform different functions, but make equally important contributions, have comparable positions?

To illustrate how such an overt arrangement that presumably satisfies this type of reward can falter, let us consider the problem of giving proper recognition to the creative scientist. Which of the following statements indicates that management truly recognizes the creative scientist?

1. "The position of research scientist is one in which we place our senior men who are not interested in administrative and management duties."

2. "Individuals occupying the position of research scientist are our most creative individuals and are the source of the new concepts on which we work."

Creation of a stimulating environment is one of the key objectives that must be realized if management desires to maximize creativity. It requires a continual interplay between challenge and response, plus the establishment of effective safeguards against the deadening impact of confusion, misunderstanding, lack of decisions, and over-administration. To enhance freedom of response to challenge takes strong leadership by management. Management must watch the organizational structure and operation to ensure that it does not restrain the individual, but rather helps and reinforces him/her.

Minimizing confustion facilitates the performance of effective work by individuals. Each person wants to know what is expected of him/her and the relationships with selected other people within the organization. Does this take strong management? Certainly it does require establishing:

1. A clear understanding of the responsibilities and authorities of different positions.

2. Positions that have real bases, both in operation and as an expression of performance.

3. Positions for "scientific" as well as management-type individuals.

A stimulating environment conducive to high-quality research activity is one in which each individual has freedom and flexibility, as well as the tools for doing effective work. This is difficult for management to implement in view of tremendous pressures that combine to promote Parkinson's Law. Adherence to a few general rules, however, can help:

1. The span or control of any manager or group leader should be so broad that he/she does not have the time to do the work of subordinates.

2. The organizational structure must show the importance of the creative researcher.

3. Whenever possible, groups should be oriented to a task, product, or goal rather than to be a technique or discipline.

When a group leader is responsible for a reasonable number of individuals, he/she is forced to manage and lead rather than to do the work of the staff. Conversely, the individuals reporting to the group leader are presented with the maximum challenge of performing with a minimum of supervision. Thus, this arrangement promotes self-reliance and individual initiative. Further, those individuals who are truly productive will "stand out of the crowd" and, consequently, management will find it easier to identify, favorably evaluate, and properly reward them.

Creative research involves the putting together of ideas and concepts stemming from different sources and disciplines. If groups are oriented toward a general task or goal and are made up of individuals selectively combined because their talents are needed to accomplish the task, we optimize creative effort. Among the other benefits, the effort required to penetrate organizational barriers in order to communicate can be used for other, more productive purposes.

To continually stimulate and challenge individuals, management should:

1. Rotate individuals to different tasks and environments, within reason.

2. Communicate regularly and decisively with the staff.

3. Establish a variety of tasks, problems, and goals, the degree of definition of each varying with the type of individual assigned.

4. Be continually receptive to new ideas.

5. Plan for corporate and business growth.

The general objective of these actions is to prevent individuals from becoming stagnant as well as to remove barriers to creative expression. Most people faced with a new challenge will rise to it, thus enhancing their own performance and simultaneously stimulating others.

Conclusion

A challenge-response-reward cycle is a sound theme or basis for managing r & d so as to achieve increased productivity and creativeness. Truly successful management of researchers should be devoted to the task of increasing the creative research potential of the staff by applying techniques that are consistent with this cycle. This will involve an apparent contradiction--between maximum freedom and strong leadership. Strong leadership will be needed to properly challenge and reward individuals. This may be obvious. What may not be so obvious is the need for management to exert strong leadership so as to guard the individuals' freedom of response and freedom of creative activity. Without this response, management is not realizing the potential of the individuals and its effect on the viability of the organization.

Session 4

PRODUCTIVITY AND EFFECTIVENESS IN EDUCATIONAL RESEARCH AND DEVELOPMENT

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Introduction

It is probably no coincidence that the questioning of the effectiveness of educational research and development expenditure which necessitates this paper, coincides with a questioning of the effectiveness of the educational enterprise itself. When times get rough the call goes out to begin studying those who are doing the studying. The implication is that this latter group--educational r & d workers--were supposed to, but have not actually been producing solutions to problems in the educational sector in sufficient quantity or quality to forestall yet another "crisis in the classroom."

Seven years ago Charles Silberman had to make a case that there was indeed a crisis in the classroom.[1] Today, fewer Americans seem to demand that they be convinced of this, indicating superficially that (a) things have gotten worse, (b) Silberman was effective in making his point, or (c) the resonses inspired in part by critics such as Silberman have indeed become part of the problem. In any case, the perceptions of the key problems which plague school systems have undergone a marked change in the past seven years. Silberman, and other critics of the 1960s such as Jonahthan Kozol, Edgar Friedenberg, and Paul Goodman, argued that with a very few exceptions, the American educational system stifled spontaneity and creativity, and thus made a mockery of what education was suppored to be about.[2] The title of Kozol's book about the education of blacks in Boston, Death at an Early Age, captures succinctly the middle-class reformer's sentiments about what schools were doing to children, and not solely children in inner city schools. Melvin Kohn's research suggests, on the other hand, that not everyone viewed this as a problem: working class parents in particular understood such "stifling" (reinterpreted by Kohn as the inculcation of behavioral patterns of obedience, neatness, and conformity to an external authority) as part and parcel of what schools were supposed to do.[3] In their view, school, like life, was not something to be enjoyed, but rather something to be gotten through.

Influential business groups, however, were also dissatisfied with American education, not so much because it did not reward spontaneity, but rather because it was getting too expensive. The solution which they advocated was a federally funded educational r & d effort which could produce and disseminate new technologies capable of controlling costs. The Committee for Economic Development's 1968 report, Innovations in Education: New Directions for the American School,[4] is a revealing document. A major fear expressed in this report was that incremental funds to the educational sector would be dissipated in salary increases

and increased teacher employment necessitated by ineffectual attempts to improve performance by limiting class size. Rather, argued CED, the key to improving education lay in improving the productivity of the individual teacher, by increasing the amount of capital with which he/she cooperated. The r & d effort undertaken in the educational sector was compared unfavorably with that undertaken by industry both in terms of the share of total expenditure (gross receipts) devoted to r & d and in terms of education's weak commitment to development as opposed to research. "The missing link in education is development research as it is practiced in industry," argued the report, pointing out that industry spent from 3.4 to 5 percent of gross revenues on r & d versus less than 1 percent in education. Moreover, 77 percent of that total in industry was spent on development, as compared with only 10 to 12 percent in education.[5]

The technocratic vision that r & d effort could be mobilized to solve educational problems in much the same way that manpower was mobilized to put a man on the moon lay behind the earlier establishment of a national network of regional r & d centers (1963) and labs (1965), under the provisions of the Cooperative Research Act. Business groups found common ground with those interested in applying the techniques of aeronautical or industrial engineering to educational systems, as well as with middle-class reformers interested in making the learning experience more spontaneous and joyful. All were in favor of changing traditional methods of instruction, and could agree on the desirability, if not the content, of that catchword, innovation.

Given this coalition for change, one might have expected dramatic results by 1977. The actual achievements have been less spectacular. Hardware advocates have had some success in developing and implementing computer assisted instruction (CAI). But the urgency and feasibility of such implementation is greatly reduced now, partly because the general economic downturn has made funds at both the federal and local levels more difficult to obtain, partly because of a general reaction against "excessive" innovation, and partly because the end of the baby boom removed some of the pressure on the costs side: average annual elementary and secondary school teachers' salaries, corrected for inflation, peaked in 1972 and have actually declined since then.[6]

The reformers did win some of their battles for a more flexible, child-oriented education. Indeed, if there is one positive thing which can be said about American education today it is that students seem to be enjoying school more. One of the few current bright spots in U.S. education is the continued increase in school participation rates. Both enrollment and average attendance as a percentage of the population ages 5 to 17 have continued to increase during the 1970s.[7] One might appeal to high teenage unemployment as the explanation of this trend, but the number of high school graduates as a percent of all 17-year-olds has declined slightly between 1969 and 1975.[8] Many high school students now hold part-time jobs, which was more difficult in the days of heavy homework assignments, and the labor force participation rates among 16-year-olds through 19-year-olds have actually increased in the past 5 years.[9] It is then at least possible that school has been made a more pleasant, if less demanding environment. On the other hand, the increasing rate at which young people take their own lives cautions against facile generalizations about trends in the happiness of the school age population.

Suicide remains the third leading cause of death for males 15 to 24 years of age, ranking after accidents and homicide. And that rate has been increasing, from 13.5 deaths per 100,000 in 1970 to 15.7 in 1972, to approximately 17.2 in 1973,[10] the latest date for which detailed statistics are available.

Whether students are happier now than in previous years, parents, teachers and property-tax payers do not seem to be. This is manifested in widespread concern with declining test scores (not all of which by any means can be attributed to the inceased numbers of students taking these tests), violence in the classroom, grade inflation, and a generally perceived decline in "standards," which many associate, rightly or wrongly, with the reforms inspired by the critics of the 1960s. By 1976, according to the Annual Gallup Poll of the Public's Attitudes Toward Education, 59 percent of the American public felt that declining national test scores indicated a decline in the quality of American education. In both 1970 and 1976, according to these same polls, the American public most frequently identified lack of discipline when asked to enumerate the major problems facing American public schools. Indeed, the share of respondents mentioning this problem rose from 18 to 22 percent over this period. But even more dramatic was the increase over the same 6-year span from 6 to 14 percent in the share of respondents citing poor curricula as a major problem. Integration and insufficient funding were each mentioned by 17 percent of respondents in 1970, but only by 15 and 14 percent respectively in 1976.[11] The educational system has shared, along with government, business, medicine, and the press in a general decline in public confidence in major institutions, particularly manifested in the years 1973 to 1976, during which period the share of respondents having "hardly any" confidence in those running educational systems increased from 8.2 to 15.3 percent.[12]

Whatever the causes of these developments, schools have, in the past decade, been faced with taxpayer revolts, in addition to the turmoil resulting from teacher strikes, desegregation crises, and a host of other problems. Whether these developments add up to a crisis, and whether there has ever been a period in American education which some did not view as a crisis situation, are questions that are not easily answered: let us agree that American education faces today problems some of which are different or more acute than those experienced in earlier periods. One of the most serious problems from the standpoint of educational r & d is a reaction against two decades of innovation, a general fatigue resulting from constant, and often contradictory, change.

It is absolutely essential that the effectiveness of educational r & d be discussed against the backdrop of the problems facing the educational system itself. We can all agree, very abstractly, that the purpose of educational r & d expenditure is to "improve" the educational process. But any attempt to measure the productivity of this effort requires the definition of outputs, or improvements. This cannot be done without a clear view of the objectives of the educational system and the problems faced by teachers and students in achieving these.

In a later section of this paper I will address the conceptual and technical issues associated with the evaluation of the effectiveness of educational r & d expenditure. These include the definition of the outputs of the educational system and thus, derivatively, of the educational r & d effort, and the

related concepts of efficiency, productivity, and benefit/cost analysis. I will also discuss some specific ways in which one might improve productivity by cutting costs and/or increasing benefits.

Before beginning to discuss these issues, however, it is worth asking whether, assuming we can do it, this effort is a necessary or desirable one. Some economists would shudder at the thought that such a question should even be asked. Economists tend to argue that efficiency is a good thing, and whatever can be done to improve it needs no further justification. Yet, if for no other reason than that we are not all economists, I think this issue is worth presenting.

It is naturally somewhat distasteful for those who form part of the educational r & d establishment to heed calls that the effectiveness of their labors be evaluated. And yet, even participants in such efforts, surveying on the one hand, the variety and extent of educational r & d expenditures in the last two decades and, on the other hand, the disarray in the schools themselves--the declining test scores, the violence, the rejected bond issues, the apparent drop in public confidence in school systems--cannot help entertaining, if only for brief moments, the null hypothesis that this whole r & d effort (if not the educational enterprise itself) has been a failure, if not a gigantic rip-off. And if it's a rip-off, then talking about productivity is a waste of time, since output cannot be identified, and the main function of the r & d effort being that it keeps r & d workers off the streets. The more money spent and the more people employed, therefore the better.

Even in less cynical moments, many can think of more important concerns than the productivity of expenditures on educational r & d. One could even appeal to the macroeconomic lessons of Keynesian economics as justification for a less than wild enthusiasm for efficiency measures. Why should we worry about minor improvements in the allocation of existing employed productive resources, when any possible efficiency gains are overshadowed by the economic loss represented by unemployed labor and unutilized capacity? A complementary full-employment variant of this argument compares any potential efficiency gains with the cost of one Trident submarine and suggests that those wishing to improve the efficiency of government expenditure should pay more attention to the Pentagon's budget, and get off the back of the NIE.

These last two arguments assume that educational r & d expenditures can and have made a positive contribution to an as yet undefined output. On the other hand, there are those such as Milton Friedman who argue, not all that facetiously, that government is the root of all evil. To the extent then, that education and educational r & d are government controlled or influenced, attempts to improve productivity and effectiveness of educational r & d are worse than a waste of time, since government can only produce bads, and the more efficient production of bads represents a net social loss.[13]

If the purpose of educational r & d is to "improve" the educational process, we can thus distinguish between those who believe that r & d work (a) has had no discernible effect on the process, (b) has had a positive impact, and (c) has, on balance, been detrimental to the process. My sympathies are with those who adopt the second position as, I suspect, are those of most participants in this conference. Friedman's argument, which reaches position (c) on a <u>priori</u>

grounds strikes me as nihilistic. Governance, like the poor, you shall always have you; the public policy debate should center around its forms, not with its desirability as compared with a world of markets, presumed capable of functioning in its absence. Some, of course, reach position (c) on empirical grounds, linking current problems to the reforms which came out of the sixties, and those reforms to an earlier round of r & d. Whether this line of argument is legitimate or not, the very real problems which school systems face today are not evidence against the proposition that things might have been worse in the absence of reforms and in the absence of the continuing r & d effort. Progress in some areas has been made, perhaps, however, at the expense of progress in other areas.

Nevertheless, we should retain a certain skepticism about the underlying premise of this discussion: namely, that current educational problems result from a failure of educational research and development, in turn attributable to a misallocation of resources among various projects, or lack of a sufficiently high level of overall funding. Participants in educational research and development are in something of a bind. If, in obtaining funding, more is claimed for research efforts than can possibly be delivered, then members of the r & d establishment risk being held responsible for the ills of the school system either because they failed to anticipate and provide solutions to problems admittedly not of their own creation, or because new problems are attributable to successful implementation of prior r & d efforts. If claims are more modest, on the other hand, then the rationale for and probability of public funding may become less. Given this bond, and given existing political and economic realities, some self-examination of the objectives and methods of educational research and development is necessary. Such scrutiny, distasteful though it may be, is one of the better means of preventing the receipt of one of Senator Proxmire's less than coveted Golden Fleece awards.[14]

The Goals of an Educational System

Accepting the position that educational r & d expenditure has made some contribution to the conduct of the educational process, we return to the question of whether attempts to improve the productivity and efficiency of such expenditures are desirable. The answer to those who point to unemployed resources and/or Trident submarines is that political and economic realities are such that the issue simply must be addressed if a continued flow of funds is to be obtained. But who should do the evaluating? The debate developing around educational r & d evaluation replicates one which has characterized the analysis of r & d efforts in other areas. Are those conducting the research to allocate resources and judge ex post facto the effectiveness of such allocation? Or is this to be done by others, outside of, or peripheral to the major research and development efforts (economists for example)? Those directly involved in the research effort also have the most specific knowledge of research problems and prospects, as well as possible conflicts of interest. Economists may be more disinterested, since they conduct a smaller proportion of educational r & d, but one should not assume that they have all, or indeed any of the answers. They have, moreover, repeatedly demonstrated that excessive faith in the utility of their discipline for technology assessment is no substitute for knowing what they are talking about. Nevertheless, economists do have a number of concepts which may be useful in organizing this discussion.

Productivity, efficiency, and benefit/cost analysis are three of the most important of these. In its simplest form, productivity is a measure of output per unit of input. It is most easily thought of in physical terms. A technique or organization which achieves higher output given certain inputs, or achieves similar outputs using fewer inputs, is more efficient in a technological sense. Benefit/cost analysis represents an attempt by policy analysts to apply these concepts to the actual problems of evaluating prospective policy decisions or programs of funding. Benefit/cost calculations require the identification of output (benefits) and inputs (costs). A program with higher benefit/cost ratio represents a more efficient allocation of resources.

In the case of educational research and development expenditure, any attempt to evaluate productivity and effectiveness requires an identification of the outputs (benefits) associated with such expenditure. The NIE Databook (1976) defines the goals of educational r & d rather vaguely as the attempt to "understand, influence and produce educational improvement."[15] "Educational improvement" is a surprisingly vague term with which to begin a document which otherwise abounds in specifics. But it does remind us again that the effectiveness of educational r & d expenditure has to be evaluated in terms of its impact on the educational system itself. The demand for educational r & d is derived from the demand for education. It is important to come back again and again to this point, lest we be mesmerized by process and lose sight of objectives. We must begin with a clear notion of what the school system is supposed to do.

Let me suggest that it is not that difficult to define the goals of our educational system. Our system should provide pupils with the sets of basic skills and analytical abilities necessary to fulfill job requirements and the requirements of citizenship in a democratic society. Primary schools (and increasingly preschools--vide Headstart) should provide all students with a platform upon which all those willing and able to go on to advanced training can build. And schools should be conducted in an orderly fashion, not simply because the previous goals can be fulfilled only with difficulty if the institutional setting is chaotic, but also because schools are an important socializing agency themselves, and children must develop to some extent the internal restraints necessary to function in a well ordered classroom if they are to make a productive contribution to the economy and society. I do not mean to imply that open classrooms cannot or should not be implemented or that we should discourage spontaneity and creativity. But even critics of the American educational system recognize today in a way they often did not in the 1960s that schools are intrinsically constraining. Compare for example, the title of George B. Leonard's 1969 book, Education and Ecstasy, with Samuel Bowles and Herbert Gintis' 1976 comments on this point in Schooling in Capitalist America.[16]

Educational philosophers and citizens in general may and should debate the relative importance of these various functions and objectives, as well as such central questions as the extent to which schools can or should be tailored or differentiated to suit children of different backgrounds, and also the extent to which schools can be effective mechanisms of change themselves. Some consensus on these goals, however, is essential if the productivity and effectiveness of education, and of educational r & d is to be treated as a technical and

not a political problem. Even then, difficult judgments may have to be rendered where improvement in one objective can be obtained only at the expense of another.

Given these definitions, we can decompose efforts to improve productivity into those which reduce costs, given program commitments, and those which increase benefits, given expenditure levels. In practice the overall responsibilities for improving benefits and cutting costs should perhaps lie with different groups in the funding r & d organizational structure. The individual researcher may have a vested interest in maximizing the value of his/her grant or contract, but also probably knows where costs can be cut with the least damage. In experimental work, smaller samples can be drawn, fewer interviews conducted, or less complex calculations made. The researcher is probably most aware of how to effect such economies with minimal sacrifice to the quality of the final research output. On the development side, the military and space efforts remind us of the important trade-offs between the rapidity with which a product is developed and the expense. We may be able to obtain quick results, but only at very high cost. Less ambitious timetables, then, are one way in which costs can be trimmed. Once again, it is the developer who is probably best informed about where economies can be made with the least effect on the quality of the final product and the date at which it is implemented. Admittedly researchers and developers may be reluctant to reveal this information and apply it; it is hoped they may be subject to persuasion.

It is perhaps asking too much, however, of researchers (and to a lesser extent developers) that they compare the value of their proposed work with what might be obtained making alternate use of public funds. Researchers have a tendency to believe that any project on which they are willing to commit their time and effort is necessarily meritorious, and it may well be, in terms of pure scientific value. It is really the responsibility of the national funding agencies to strike a precarious balance between the support of mission-oriented, or applied research, and more basic research. Such choices involve decision making under uncertainty, and should be made using the best scientific, engineering, and organizational advice available. But it is not a responsibility which can be abdicated. Funders must take a hard and comprehensive look at the benefit side. Much academic research can be justified on the basis of scientific merit. This does not necessarily warrant federal support. One of the most salient arguments for establishing a National Institute of Education was the need for a clearly articulated and coordinated r & d policy.[17] It is not clear that this has yet been achieved; the r & d effort can still be criticized as haphazard and piecemeal.

This not to say that definition or r & d goals should be sought for the sake of definition. A controlled eclecticism may be in order. Many in the educational r & d establishment seem particularly enamored of the military-space-industry model of the r & d process and, furthermore, seem to have become more so in the past several years. Compare for example the 1970 Office of Education report on Educational Research and Development in the United States with the 1976 National Institute of Education Databook: The Status of Education Research and Development in the United States. The latter document speaks almost

exclusively of r & d outputs as "products" to be sold to users. To complete the analogy, research seems to consist of developing new products; development with market research and sale. The military-technological-industrial model appears to have a powerful hold on those currently thinking about educational r & d. The earlier document evidenced a more catholic interpretation of what educational r & d consisted of.[18]

It is worth remembering that the modern conception of how innovations are produced is comparatively recent. Most innovations in the eighteenth and nineteenth centuries were due to the efforts of creative, nonformally trained individuals tinkering on a part-time basis, often alone.[19] We must at least recognize the possibility, as does Nelson, that "the understanding and technique will evolve...through the experience and sharpened imagination of people who are actually trying to deal with the problems, not through the data gathering and theorizing of people with fancy degrees doing something called r & d."[20] Even in the twentieth century the r & d structure on which the educational effort is now modelled has not always lead to successful innovation. Massive r & d support for the British airframe industry, for example, led to a series of technological successes, but commercial failures.[21] Similarly, many military r & d projects have had to be abandoned, or have been carried through only at enormous expense, producing final products which did not live up to expectations.

Finally, we should be aware that even a heavily supported r & d effort may simply be unable to produce some of the innovations expected of it. The development of an effective teaching machine which could even approach teacher replacement may be beyond existing or foreseeable engineering and scientific capabilities. Some problems which appeared easily soluble using modern computer technology have turned out in practice to be much more intractable than had been anticipated. The translation of language by computer is a prime example.

Extreme pessimism is not warranted; a good deal can and has been done. But it must be recognized that since educational r & d covers a wide range of activities, the organizational forms suitable for some of these activities may not be suitable for others. What are some of these varied activities? We have at one extreme those who concern themselves basically with how children learn, and at the other extreme with what they should learn. Most "pure" research is done by those with advanced degrees in education or psychology and is conducted within an academic environment.[22] Such efforts have in the past yielded extremely useful information, in particular, a greater appreciation of the importance of the preschool years in the process of child development. This research formed part of the rationale for such programs as Headstart. At the other end of the r & d spectrum, we have those concerned with what children should learn. Here again, there are some successful models--the PSSC, BSSC, and SMSG efforts in particular. It is obviously not very useful to do a good job teaching children incorrect or obsolete information or analyses. The most notable successes so far have been in the hard sciences; such curriculum development may be more difficult in the social sciences where there is less consensus on what constitutes received doctrine, although recent textbook controversies indicate that even the hard sciences are not immune to such controversy. It may also be more difficult to enlist competent personnel for curriculum revisions below the high school level.

In between these two poles are those who concern themselves with the best means of transmitting curriculum to children: they develop and study the effectiveness of such innovations as different forms of classroom organization, language labs, computer assisted instruction, or the use of public television (productions of the Children's Television Workshop being a successful sample). Finally, of course, some educational research consists primarily of data gathering: producing an information base which may faciliate some of the r & d efforts just described.

The diversity of this effort should be respected. It is somewhat disturbing that the most well known and successful of educational innovations in the past two decades appear to have originated in the late 1950s and early 1960s as the result of research authorizations under the Cooperative Research Act of 1954 (as amended), also the period in which the National Science Foundation gave its heaviest support to curriculum development in the sciences at the high school level. Most of this work was done through contract or grant arrangements with colleges, universities, or state educational agencies, rather than a network of r & d labs and centers. Some of the innovations to come out of the r & d labs and centers in recent years may eventually prove themselves, but the fact that their introduction has coincided with an increased public concern with inadequate curricula is at least a cautionary note.[23]

Within the terminological framework of benefit/cost analysis, the responsibility of improving benefits given expenditure levels belongs primarily with the national funding agencies, partly because they control the preponderant share of resources going into educational r & d and partly because they, as opposed to the researcher or developer, can be expected to have an overview of the process. This responsibility entails decisions about organizational structure, direction of r & d, and implementation. Cost cutting per se may keep us within lowered budgetary commitment, but will do little to improve the overall research effort. The decisions are not easy: do we wish to concentrate on the development of new products--curricula or blueprints, or should we rather build from strength, concentrating on the implementation of proven programs, those tested and found successful already?

In education as well as elsewhere, the problem is in part one of leadership--not leadership for the sake of leadership, for it is better to wander aimlessly than march in unison down blind alleys, but effective visionary leadership: decision makers with the capability of transcending the matrices of individual interest, seeing to the heart of the problems and identifying the areas which are most likely to repay a wise investment. Implementation, likewise, requires leadership. School systems are organizations, and they have limited capabilities for absorbing innovation. The funding agencies, in addition to allocating research funds, have a responsibility much like that of the FDA to screen out potentially harmful new products. The danger in the educational sphere is less that ill-conceived innovation will permanently damage students as would their ingestion of a toxic substance, but rather that unnecessary change saps the abilities of organizations to absorb future innovations which are potentially far more beneficial.

One should use market metaphors with care in discussing educational r & d. Selling a reorganization or new product to a school system is not the same as selling a marginally useful product to the American consumer. The latter does not seem adversely to affect the consumer's willingness to purchase future products. Most educational innovations, on the other hand, even if centered around hardware, involve reorganization. Frequent and/or ill-advised reorganization increases future resistance to such efforts, and reduces the possible benefits to be obtained. This resistance may take overt or covert forms, and is complicated by the fact that there is relatively little direct control over what goes on in the classroom. Unless innovation is conducted carefully and selectively, future options may be foreclosed.

When Lyndon Johnson declared war on poverty, a great many people took him seriously. When Gerald Ford urged us to whip inflation now, fewer listened. When President Carter declared his attack on energy to be the moral equivalent of war, many people went to sleep. And yet there is every reason to believe that the energy problem is a potentially very serious one. The situation with respect to educational innovation is similar. In our political system, effective innovation requires commitment from a great many different individuals, and the ability to organize that type of commitment depends to some degree on how frequently it is demanded. This problem is compounded today by the difficulties of continuing innovation and reform in an essentially conservative era, an era of retrenchment in which the commitment to move forward in building a better society seems stalemated or in retreat wherever we look. Money is, of course, important in implementation, but it is only part of the formula.

In thinking about the military or the industrial models of r & d, note that the educational product development cycle differs in important regards from either. Education shares with military-space r & d the fact that government provides most of the r & d funds. It shares with the consumer product development cycle a large number of final consuming units, in contrast to the military-space model. It shares with neither a preponderance of not-for-profit organizations in the actual conduct of r & d. These differences serve as a reminder that the educational r & d effort is a unique and diverse one, and we would be ill-advised to force all elements of it into a preconceived mold.

Development without implementation is tragic if the innovation is a good one; its a blessing if it is marginal. Innovations must be utilized, however, if they are to show up in the benefit column of any benefit/cost calculation. The funding agencies, with the advice and consent of the r & d community, must make critical decisions regarding the focus of research, development, and implementation. But action for the sake of action may be worse than no action at all. In France or the Soviet Union, the decision of one government ministry assures the adoption of a new text throughout the country's school system. The absence in the United States of a federally controlled educational system imparts some bias against new innovation which can delay the utilization of potentially beneficial techniques. It also provides some (although it is not clear how much) insurance against catastrophic failures.

Conclusion

In concluding, I am reminded of our responsibilities to be clear, concise, and to the point. We wish to avoid the convening of conferences on the

productivity and effectiveness of evaluations of the productivity and effectiveness of educational research and development. In this spirit I will summarize the main points of this paper. First, the productivity and effectiveness of educational research and development is primarily a function of its impact on the educational system itself. In the short run, cost savings on existing projects may keep us within budgetary limitations. They do not, however, necessarily provide the key to long run productivity improvements. Second, whatever the unpleasantness which results from cost cutting, and benefit evaluation, such steps are politically necessary if funding is to be sustained and, indeed, if the claim is to be justified. Third, the educational research and development effort is a diverse one, and this diversity should be respected. No one organizational form is correct for all elements of this process. Fourth, ill-conceived innovation is worse than none at all. It is doubly damaging in that not only may it lead to performance loss in the present, but it may also foreclose options in the future. Finally, to assure the long run direction of energies toward areas which will yield major benefits, we need courageous, wise and, perhaps, also lucky decisions; the supply function for which seems unfortunately to be rather inelastic. Let me close with an appeal, once again, for a controlled eclecticism, and eclecticism which permits direction in our efforts, yet flexibility enough when conditions change, to allow for course alterations.

NOTES

1. Charles E. Silverman, Crisis in the Classroom: The Remaking of American Education (New York: Vintage, 1970).

2. Jonathan Kozol, Death at an Early Age: The Destruction of the Hearts and Minds of Negro Children in the Boston Public Schools (Boston: Houghton Mifflin, 1967); Edgar Friedenberg, Coming of Age in America (New York: Random House, 1965); Paul Goodman, Compulsory Miseducation (New York: Vintage, 1964). See also Ivan Illich, Deschooling Society (New York: Harper and Row, 1970).

3. Melvin Kohn, Class and Conformity: A Study in Values (Homewood, Illinois: Dorsey Press, 1969), cited in Samuel Bowles and Herbert Gintis, Schooling in Capitalist America: Educational Reform and the Contradictions of Economic Life (New York: Basic Books, 1976), p. 146.

4. Committee for Economic Development, Innovations in Education: New Directions for the American School (New York: Committee for Economic Development, 1968).

5. Committee for Economic Development, Innovations in Education, pp. 29-30, as summarized in U.S. Department of Health, Education, and Welfare, Office of Education, Educational Research and Development in the United States, (Washington: Government Printing Office, 1970), p. 165.

6. National Education Association, Annual Estimates of School Statistics, as summarized in U.S. Department of Health, Education, and Welfare, National Center for Education Statistics, Digest of Education Statistics, 1976 Edition, p. 57; salary figures deflated by Consumer Price Index.

7. U.S. Department of Health, Education, and Welfare, National Center for Education Statistics, The Conditions of Education, 1977 Edition (Washington: Government Printing Office, 1977), Table 2.01, p. 162, hereafter cited as Conditions of Education, 1977.

8. Conditions of Education, 1977, Table 2.18, p. 174. The percentage fell from 75.7 percent in 1969 to 74.4 percent in 1975.

9. The following table indicates the increases in labor force participation rates between 1970 and 1975:

	Males		Females	
	16-17	18-19	16-17	18-19
1970	47.5	69.9	34.9	53.7
1975	49.0	73.0	40.2	58.3

U.S. Department of Labor, Handbook of Labor Statistics, 1976 (Washington: Government Printing Office, 1976), p. 25.

10. U.S. Department of Health, Education, and Welfare, Public Health Services, Health Resources Administration, National Center for Health Statistics, Vital Statistics of the United States, vol. II, Mortality, Part A (Washington: Government Printing Office, 1974, 1976, 1977), Tables 1-42. The 1973 data breaks down the suicide rate for the first time by 5-year age intervals. For 15-19 year olds it is 10.7 per 100,000; for 20-24 year olds, 24.1.

11. Phi Delta Kappa, "Eighth Annual Gallup Poll of the Public's Attitudes Toward the Public Schools," Phi Delta Kappan (October 1976), as cited in The Conditions of Education, 1977, Table 1.15, p. 158. For an indication in the popular press of current public dissatisfaction with American schools see the cover story: "High Schools in Trouble: A Tale of Three Cities," Time, November 14, 1977, pp. 62-75.

12. National Opinion Research Center, General Social Survey, as reported in Conditions of Education, 1977, Table 1.14, p. 157. It is only fair to point out that education suffered relatively less in this regard than some of the other major institutions.

13. See for example, Milton Friedman, "The Economy and You: What Lies Ahead?" The Stanford Magazine 5 (Fall/Winter 1977) pp. 22-27, esp. p. 27.

14. From time to time Senator Proxmire presents a Golden Fleece award, usually in absentia, to those who have managed, in a particularly artful or imaginative fashion, to waste government money.

15. U.S. Department of Health, Education, and Welfare, National Institute of Education, The Status of Education Research and Development in the United States, 1976 Databook (Washington: Government Printing Office, 1976), p. 1.

16. George B. Leonard, Education and Ecstasy (New York: Delta, 1969); Bowles and Gintis, Schooling in Capitalist America, p. 272.

17. See U.S. Department of Health, Education, and Welfare, Office of Education, Educational Research and Development in the United States (Washington: Government Printing Office, 1970), p. 185.

18. Documents as cited in footnotes 15 and 17.

19. Richard R. Nelson, The Moon and the Ghetto (New York: W.W. Norton, 1977), pp. 58-59.

20. Nelson, The Moon and the Ghetto, p. 63.

21. Nelson, The Moon and the Ghetto, pp. 122-123.

22. U.S. Department of Health, Education, and Welfare, National Institute of Education, 1976 Databook, pp. 46-47.

23. See pages 44-46 of U.S. Department of Health, Education, and Welfare, Educational Research and Development in the United States (1970) for a review of the history of federally funded educational r & d. The National Institute of Education's 1976 Databook contains a list of recent "exemplary products of educational r & d," pp. 52-55.

Session 4

ANOTHER VIEW ON PRODUCTIVITY AND EFFECTIVENESS IN EDUCATIONAL R & D

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In his paper, Dr. Field emphasized that productivity and effectiveness must be seen as a function of the impact of educational r & d on the educational system itself. I think this is true; but it is not enough. In order to amplify that view, my remarks will mesh, in some places, and complement, in others, what he has said. When what is being discussed is educational r & d, then I think it important to keep several different reference points in mind. One very important one is the short history of this particular knowledge production system itself.

First, a brief word on my own orientation to the question. Even those familiar with the Learning Research and Development Center (LRDC)--with what it has already produced and is currently pursuing--may not be familiar with the organizational mechanism my work represents.

Since it inception, LRDC has had a Board of Visitors, noted scholars in the fields represented in the center. Ralph Tyler was chairman of this board for its first 10 years; Wayne Holtzman is the current chairman. The board has had a resident staff of sociologists who "live" in the center. What this means is that the organization has been continuously studied for 13 years by people whose perspectives are the sociology of knowledge and of organizations. Our methods are anthropological; the center is our "tribe."

This has served to make us very familiar with knowledge production processes in the one case, LRDC, and somewhat knowledgeable about the field as a whole. The center's history, having been one of the first two centers funded in 1964, spans the entire period of federal, and other initiatives to vastly increase the size and the impact of educational r & d. This is the history of the imposition of the "scientific model" on education.

Questions regarding productivity and effectiveness must be asked within the context of understanding of organizations and goals. For educational r & d, this means some understanding of the field as a whole, as well as of its component organizational parts--the way these are structured, the variety of missions or objectives they comprise, the history each encompasses. Dr. Field

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touched on this in his discussion of the eclectic nature of the r & d system. Taken together, the presentations at this conference reflect this diversity.

I shall discuss some evidence of productivity, largely defined in terms of characteristics of knowledge production. In a young field, one looks for: the development of new paradigms, or the extension of or borrowing from others of old ones; changes in standards of judgment; system growth and differentiation.

Looking quickly at the field as a whole, we can start with the reasons behind those early, and later, federal initiatives. It has been well documented that prior to the Cooperative Research Act of 1954, and between the passage of that and the initiation of the center's program in 1964, educational research was fragmentary, noncumulative and, increasingly had become out of touch with advances in the social/behavioral sciences. (This, with some rare exceptions, of course.)

The center's program was intended not just to produce specific innovations, but to impact the field, the field of educational research and the field of educational practice. The idea was to provide: structure, leadership, and new models and standards of judgment. Field has alluded to the first two of these in his paper, but not to the last, which is a significant one.

Starting with this last, standards of judgment, there are some interesting indicators of the effectiveness of the r & d movement. Leaders of laboratories and centers, and other institutionalized r & d have made prominent new standards of quality in applying scientific concepts and methods in education. For example, it is an unquestioned part of the r & d cycle that innovations--new curricula or other newly developed products--will be pretested, systematically developed, and evaluated, and that they will not be introduced simply on the strength of enthusiastic commitment. This emphasis on fairly specific conceptions of standards sets the r & d reform movement in education apart from other efforts to improve American education as, for example, in the "free school" movement.

The systematic development of curricula, of tests, of instructional modules, of administrative innovations, has begun to have traceable effects within industry, publishing houses, and among schools of education, institutions training the next generation of teachers and scholars.

A salient characteristic of the field in the past 15 years has been the growing prominence of people in the forefront of the traditional behavioral science disciplines conducting work of relevance and importance to educational problems. It is these traditional disciplines, e.g., psychology, that are the custodians of standards and criteria of excellence in scholarship. And, it is through the increased presence of researchers from these fields that scientific standards have become the standards for educational r & d.

What the r & d movement has made possible is a fostering of communication between the behavioral science disciplines and education. It is possible to see now the changes which have taken place, when one compares the r & d centers currently, with their representation from psychology and sociology and a few other disciplines, with the rather parochial nature of educational r & d at the time the centers were established.

It is an indicator of the better position of educational research, as an intellectual pursuit, that leading scholars in the behavioral/social sciences now address questions of reading instruction or the measurement of school program effectiveness in ways not previously undertaken. In addition, there is growing evidence of the influence of educational concerns on the basic disciplines, on the way questions are asked or research designs are framed.

It is interesting also that there are areas in which the traditional experimental design may now be seen by many as less than appropriate, e.g., in many studies of school effectiveness. Yet, the need to counter the experimental paradigm, and the attempt to come up with an equally rigorous if different design has, it is generally agreed, improved the quality of this whole area of research.

There are other structural changes as well. In this vein changes in the organization and functioning of the American Educational Research Association (AERA)--the professional organization which represents this field--can be taken as indicators of the effectiveness of the move to bring science to bear on educational concerns. These changes reflect changes in knowledge production in the field in general.

As the field of educational r & d has grown, so too has AERA--in its membership, its number of divisions, its annual meeting attendance. Without enumerating these specifics, the important thing about the association, as about the field in general, has been its growth and its differentiation.

In the past decade, AERA has developed more and more specialized divisions, special interest groups, and a larger and more diversified set of publications. The literature on modernization and institution building talks of the coming to maturity of societies and social groups and points out as indicators of this process: system growth, systemic differentiation, and resulting institutional specialization. We can view these also as criteria against which to measure growth in a developing intellectual field such as educational r & d.

The r & d system for education has grown tremendously in 13 years and has, in fact, developed a strong leadership, in part reflected by the membership of this organization, CEDaR. It has developed a fairly differentiated structure, organizations of several kinds to meet varying needs: labs and centers, the ERIC system, field based programs such as Follow Through and many more. And it has more significantly set high standards and criteria of judgment regarding scholarship and production.

Any analysis of the current state must mention the need for: including a greater variety of the social sciences in the knowledge production process; working to build more extensive communication between the r & d system and schools across the country; working to better communicate the significance of work past and potential to a larger segment of the American public.

I've proposed several criteria which I think might be useful to keep in mind when considering questions of productivity and effectiveness in a young

but growing intellectual field. There are indicators of: (1) system growth; (2) systemic differentiation; (3) specialization as well as of growing leadership and, most importantly; (4) increased use of scientific standards of quality for knowledge production. These criteria are related both to the initial goals and objectives of federal involvement in educational r & d and to how we think about and characterize growth and development in a number of domains. I'm sure others could add to this list and will want to.

Session 5

THE FUNDERS' PERSPECTIVE ON PRODUCTIVITY AND EFFECTIVENESS - I

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I found this a devilish difficult topic to deal with and I would like to just say a few words about it at two levels. One level is how we run our procurement policy; in other words, how through our techniques and procedures we try to make the research and development effort which we are purchasing more productive. The thrust of that will really be to confess the limitations on our leverage, on any such control perspective, because I think that is indeed the moral of my little story. And then I'd like to talk very briefly and generally about what some paths to real productivity in r & d might be.

A simple definition of productivity is output per unit cost--that seems to be what the economists call productivity--and that's the measure of productivity that gets converted into what we call benefit costs and cost effectiveness equations, when we move into broader evaluated frameworks. But it seems to me that between the notion of productivity and the notion of research and development there is really a fundamental contradiction. In r & d to some extent by definition output is unknown; and if the output were known, it wouldn't be a research question. We are all seeking for an answer that isn't there. And so while we are searching we use all sorts of proxies like how many reports there will be, and how many sections each report will have, and how many people will work on the report and so on; those are all really proxies--and fairly weak proxies at that--for any direct measure of output. And output is defined as some question answered or some practice improved. Yet the procurement system under which we operate has the fundamental implication that productivity can be achieved. There are questions of efficiency and effectiveness that the procurement process can and should deal with to get government more "for its dollar" but I think the question in r & d that is ultimately unresolved is, "more what?"

I don't see any trend in federal procurement policies but that there be greater demands for productivity. Certainly in HEW this is the case. A month ago a large-scale procurement conference was called at the Secretary's behest in which not just beleaguered contracting officers, or even beleaguered deputy administrators, but beleaguered agency heads sat around for a day or two being --we won't say indoctrinated--but advised of the requirements of procurement policy. We have an HEW circular coming out with more vigorous contracting requirements: more clout for procurement officers; more requirements to identify what the monitoring requirements will be before the contract is awarded; what the site visit schedule will be; how quickly the program officer must report any slippage to the contracting officer; how many days after the completion of the contract will the program officer write a full report to the contracting officer as to the fulfillment of the requirements.

The whole procurement process bottomed, as I said, on the notion of productivity. This emphasis on productivity is making the use of those procurement instruments more and more difficult in the area of research and development. At that conference, my job was to tell them that at the very least in working up procurement regulations, they should have some separate sections and separate requirements for the purchase of research and development, as opposed to the purchase of pencils and the rental of large buildings and so on, that may occur. I must say there is still a considerable reluctance to do it. It probably would require something that does not exist in the federal government, and that is an entire cadre of procurement officers whose specialization and career lie in the area of research. Such officers are rare indeed and for that system to operate well, it would require many more than presently exist.

Another trend, I think, will be toward more contracts in general. I mean the underlying logic would be toward fixed price contracts rather than cost plus. This is particularly important for NIE because NIE historically has sought productivity through the procurement process. The results of a report that the staff recently did in response to some of the Campbell committee recommendations to our National Council,* showed that NIE has relied a great deal on the procurement process as its path to productivity in r & d. Between 70 and 85 percent of our expenditures in the past several fiscal years have gone out in form of contracts, either competitive or sole source. Last year, by way of a sort ordinal of other numbers, we put out something like 35 major RFP's including not just those to your organizations but other major competitive procurements, and we ran three grants competitions in an unsolicited proposal process. So you can see where the weight of NIE's efforts has lain. And it is much more so than other research agencies. That was another point this report makes and one that we have just begun to reflect on. I think it is going to take us a little more time to face up to its implications--that this whole procurement thrust may be in some important respects if not a blind alley, a short street that may not take us too far toward productivity.

The Campbell report was really quite good on that--this process--and in spelling out its limitations. I will just read some of these sentences from the Campbell report because they pretty much reflect some of the observations I would have made after just a few months at the agency. "It is not always true that the agency staff can write clear and useful specifications for what is wanted." True.

"The costs of bidding are eventually added to the government's costs of future procurements." True.

"When there are only a few good performers for a given type of work, the rest of the competitors have little chance and their costs of failure are a drain on energy and time that might be avoided."

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* R & D Funding Policies of the National Institute of Education: Review and Recommendations, Final Report of Consultants to the Director and the National Council on Educational Research, Roald F. Campbell, Chairman (Washington, D.C.: National Institute of Education, August 1975).

On productivity: "Extensive competition among a small number of organizations capable of large-scale work in educational r & d may tend to promote disentegration and secrecy."

"Where proposals are judged by interested staff, the current procedure prevents them from working with proposers, to look at ideas, or to review advance copies of proposals so as to avoid submission of obviously unresponsive or unqualified ones." That's interesting to pause and comment about a bit. For some reason I don't fully understand, NIE and HEW as a whole are under greater constraints in that area than are some other federal agencies. It appears from this report that NASA and quite a few other agencies have for a long time had extensive advance discussions and its been all quite copestic. But it's quite clearly constrained severely if not totally prevented by HEW regulations.

So those, I think, are some pretty interesting observations on the limitations of procurement process, the process upon which NIE has relied probably most heavily. Now, what is the procedural alternative? The procedural alternative is the grant. As far as I can make out, other--various in betweens--have been proposed.

The grant, in theory, offers some advantages over the contract in terms of productivity of r & d. If the peer review process is thorough and of high quality, and if the agency runs an intelligent grant process over a series of years, I would say that that way ought to be the path to productivity. The real path to productivity is in a vigorous r & d system, not in any control efforts that we are likely to be able to effectuate.

It turns out that in HEW the process of making grants is very complicated. When we go to do a grant competition in, say, basic skills (which is one we are doing now) we have to go through the identical procedures that the Office of Education has to go through to put out its regulations on Title I. Under the HEW regulations, a grant is a grant is a grant. That it is a grant to a state or locality to run a program or a grant to an individual researcher to perform a project, is not well distinguished at all in the HEW regulations. So in the case of the basic skills grant, it took us, I believe, 18 months from the beginning of trying to put out a grant proposal until we got it out the door. Once again this does not appear to be true in every other agency. NSF has a generalized regulation for grants competition and it runs all its grants competitions, year in and year out, under the same regulations--puts out the little notice saying this year or this month, the following is our topic and away it goes and out goes the money. Again, for reasons I am just beginning to explore and understand, HEW--not just NIE--but HEW is not in that position and I think that is an issue we have got to worry about.

So that puts us in a real pickle in terms of the instruments we have available and the controls we can put on them if the contractural process uses up enormous amounts of our time. It is based on the assumption that we can specify all kinds of things that we probably can't always specify very carefully in terms of performance of research. And the grant process is so slow moving and difficult that we have the unproductive situation of waiting a year

or so before being able to do anything, once we have decided to give some grants. So I think we are under some constraints and I really think that while we could make that process more efficient, the constraints are really rather normative. After all, while we are a mission agency, while we do need to give out our resources according to certain priorities that Congress has set upon us, it is research and development that we are dealing with. We are not going to have the resources nor the wisdom to bring about much increase in productivity in r & d just by pulling the few strings we have. I think to some extent we have tried that and to some extent it hasn't worked.

Now we have begun to try to shift patterns of our procurement a little bit to the extent that we have instruments available. I think that the longer term contractural arrangement such as is envisioned in the process that we are all going through now, is probably in some cases an instrument which offers a little more realistic management of educational r & d than does the short term RFP. I think that with all their limitations, some of which I hope we can get relaxed, grants do offer more possibilities than we have realized so far. I think, for example, that we have never really been genuine in our opening up our grants competition. We have never really had the kind of trust in the field that a grant competition implies. We have never made peer review more than advisory in either grants or contracts, and while we have to proceed with care in this area, I think that some expansion of grants competition is probably one path we will take to at least try to increase productivity by building the health of the system, if you will, rather than through control mechanisms. This is not to say that we won't be responsible for the lawful and efficient expenditure of federal funds, and the day will never come when you just get your checks in the mail as from Social Security.

I think that we are going to be searching for a balance, but that balance will be constrained because none of the instruments available are that terrifically great on enhancing r & d productivity in the short run. So that leaves me at the end with just a general kind of statement which is that productivity in an r & d system, at least from a federal agency perspective, will be manifested more or less in the overall health and vigor of that system. I think that, in general, we have to approach productivity indirectly and in terms of the whole NIE program rather than directly and through the performance of specific projects.

Session 5

THE FUNDERS' PERSPECTIVE ON PRODUCTIVITY AND EFFECTIVENESS - II

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I guess my task is to talk about how the Department of Defense, in general, and the Navy Department, in particular, attempt to ensure productivity and effectiveness in educational r & d. However, I have to give you the obligatory disclaimer that my remarks are unofficial and do not reflect official policy of either DOD or the Department of the Navy.

From what I've heard, it seems that DOD's funding strategy for our DT&E is maybe in a little better shape than some of the other federal agencies' funding strategies. In particular there are various categories of money which are budgeted for from basic research, on the one hand, to transition, to operational use on the other hand. Some of you may or may not be familiar with this, but there are more or less six categories of money that can be applied to this process beginning with independent laboratory research through exploratory development, advance development, engineering development, management, and support up to operational system development. I think the leg-up that this gives us is that there is explicit funding for the transition of products to the users.

DOD runs its work in a couple of ways. There are various agencies with DOD that fund basic research and some of the more advanced development kinds of things. The main ones are the Defense Advance Research Projects Agency and then in the Navy, the Office of Naval Research. The organizations that are responsible for more of the advance development of products that are likely to be more applicable to particular service problems are my organization, Navy Personnel Research and Development Center, the army's organization which is the Army Research Institute, and the Air Force Human Resources Laboratory.

If you think a little bit about it, the military does an awfully good job in training. It's a huge training establishment and during peacetime can be likened to a large junior college. The Navy, for example, has something like 5,000 different training programs, courses, or schools for which it is responsible, and its problems are very serious. They include the declining manpower pool; the increasing technological complexity of all of the weapons systems, propulsion systems, and so forth; and particularly the decreasing dollar support for manpower and personnel.

The military also does a reasonably good job of transitioning r & d to operational use. Most of the developments in educational research have had their history, kind of their birth in the military. This began primarily during and after World War II with the psychological sciences branch of O&R and other agencies like that, and resulted in products like job task and content analysis systems approaches to training. The Navy, for example, right now runs the

world's largest computer and its instruction system. So they have been reasonably up on things.

Like most of the other government agencies, the work that is done out-of-house is done mainly on contract and not much on grants. And as most of you know, those kinds of things are competitive procurements, sole source procurements, and unsolicited proposals which are also sole source. Now, at our particular organization, given the problems that Mr. Timpane has mentioned in the procurement process, there is not a whole lot that we can do to maintain productivity or effectiveness because when the government is letting a contract, it is buying a product, and unless it is very careful, it can't do much about specifying how that product is to be developed. As far as insuring effectiveness is concerned, our organization--we are primarily concerned with application of products to Navy problems, especially in the latter funding categories (the advance development and things like that)--is a little better off than some others, in that we fund about half of our budget in out-of-house work and the rest is in-house. So, for example, I monitor a couple of contracts but I also do a lot of research in-house, so I am on both sides of it. And we are continually required to justify everything upstairs, just like everyone else is.

Anyway, all of our work is fairly programmatic and, therefore, we are unlikely to fund anything that doesn't contribute in some way to the programs that we are interested in at the time. The main concern is the usability or utility of the products resulting from our r & d and, therefore, the efforts that we fund are going to have to have a high probability of resulting in a product which may be applied in Navy education, or training, or manpower, or something.

Once the work is contracted, about the only recourse we have is to monitor closely. We attempt to ensure Navy application and that means that, when possible, the work should concentrate on Navy problems, Navy subject matter, Navy research subjects or students. Also, because we have an in-house staff, we do most of the follow-on work, including the prototype test and evaluation, and then transition to the operational users.

Now one of the things that has been laid on us in the past year or even before that, is the requirement for cost/benefits analysis on almost everything that comes out. We are required to specify the implementation costs and all the attendant costs, that would be involved in implementing some innovation in education and training systems. As far as productivity goes, about the only things that we can do are attendant with the contract process during procurement, during the initial evaluation of a proposal or during the specification of an RFP. We have to be very careful about how we specify what the contract is for. We can assess the ability of proposed contractors to complete the work as proposed or as requested and that's one of the criteria with which procurement decisions are made. We can assess the reasonableness of costs of completing work, although that's not ordinarily done by the technical people; that's done by the contract people and those two processes are separate for competitive procurements in particular. And then in the contract, all we can do is require frequent progress reports, data items, and descriptions describing how the work is progressing and what's happening. And, finally, we can include requirements for review and approval of final products before the contract is completed.

We have, as I mentioned earlier, the same problems from our perspective as researchers: we are continually required to demonstrate that we have been productive. One of the things that happened recently was the GAO got more or less "sicced" on Department of Defense human resources r & d about a year and a half ago. So the GAO came through and looked at all of the DOD r & d labs. Those people are mainly accountants and they like to count things, so they then went to users of our research and asked them if they had ever heard of our research or used it. They came back with the finding that about 30 or 40 percent was not used, and they seemed to be somewhat upset about it. I was kind of gratified that, if you turn it around the other way, 60 or 70 percent of it was used.

Session 5

THE FUNDERS' PERSPECTIVE ON PRODUCTIVITY AND EFFECTIVENESS - III

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We have somewhat the same problems as the educational people who are working on a social problem, so to speak. I think we are probably under the same gun right now from a federal standpoint as many of the other social programs in the United States government. We, too, have to account for actions. We have many different problems than you might find in the DOD; in fact we looked at the DOD model in constructing the Institute eight years ago and one thing we found different from DOD was that our buyers are not within our own organization. Therefore, the decision to go into basic research or into applied research or to implement, was among many different parties, so this complicates the problem of decisions all along the process. In response to Mr. Timpane's message, I would think that all federal agencies right now are being asked to clean up their internal procedures. We, too, are being asked to go more towards the contract mechanism but we've had somewhat more liberty, perhaps, than HEW, being an organization which is much newer and much smaller in stature and funding.

We have outlined a very new procedure with respect to basic research. We will fund all of our basic research using concept papers, program announcements, and the grant mechanism. The grant mechanism would be a virtual gift to the grantee, as compared to a contract where we would expect something to be delivered to the United States government, perhaps a set of punch cards or a final report, something like that. With a grant, we wouldn't expect anything to occur: we would expect at this particular time to determine exactly how much of our research money goes into basic and applied research.

We have just undergone review by four major institutions: the House Committee on Science and Technology and the Judiciary Committee of the House; the American Bar Association; the National Academy of Sciences; and a Department of Justice study which was initiated soon after Carter came into office. The consensus that we can see--and we have just completed this analysis--is that we may go down the same path as the National Institute of Education. It appears that the Congress, the National Academy of Sciences, and everyone who has looked at us over the last 8 years, would desire much more independence on our part. Essentially we have been too politicized, according to them. The agency heads have used our research money for action programs and by direction or edict or whatever you want to call it. It would appear that the Congress will not succumb to any Department of Justice move which would do otherwise, so we may become an independent agency.

However, during the hearings the same message came through as the subject of this particular conference on productivity: What do we get from our research? What we are trying--and it's my job as the head of a new office in the Office of the Director--is a new analytic unit to look at the long-range aspects of the National Institute, to answer such questions as productivity and to see and hear what other people have to say in other fields. We have just started a five year program (the program announcement is on the street right now for anybody who might be interested in it) to try to define the performance measures of the criminal justice system so we can get some kind of an idea as to where we are making improvements. If we can find out when our research is aimed at an improvement, we can possibly measure the benefit and the cost of establishing such an improvement.

We have seen, for instance, data that is published by the U.S. Bureau of Census on the private sector--all the various industries, the productivity that they have, their costs of employees, their wage bills, salaries bills, value added, the number of shipments, the value of the shipments, and things like this--and we believe that the criminal justice system can be an econometric model similar to that through which at least one agency compares itself to another agency, from a relative standpoint anyway. Exactly what the agency is doing for its money may only be measured relative what another agency might be doing and getting for the taxpayer. We are also going to try to develop some benefit and cost standards in our functional area. If we do move more toward that type of measuring scheme, I think there is some credibility in the standardization of cost accounting data in the United States government and what one is willing to pay to obtain a particular benefit. We tried a little bit about this at the national level but may the best man win in getting the budget.

We are a very new agency and with respect to productivity, I fully agree with a lot of what has been said in the last day with respect to the organizational aspects of trying to increase productivity through organization. We ourselves are trying increase research and development capacity in the United States by doing most of our research outside of the National Institute. I was surprised to hear--and if someone can confirm this number--that the number of research and developers or research people in the field of education may only range from 3,000 to 15,000. I don't know whether that is correct or incorrect but it seems to be a very small number. We are aiming at much higher numbers than that if we can build the capacity. Obviously we are going to be very inefficient in building this capacity because we probably can lure people in for the time being and then they might find other endeavors. I would like to see a lot of work done in the area of long-range capacity building because I think that has a lot to do with increase in productivity of the research community, whether it be associated with the educational field or the field of crime.

I might add one other thing that I have heard. I have heard such numbers as grant effectiveness being around 15 percent. In other words, out of 100 percent of the granting monies, 15 percent are effective. Now that may or may not be correct but it is to me an interesting measure if it is correct. I don't see anything very bad about that. I think that is actually higher than I would estimate it to be.

One other thing is that I think we are finding a phenomena in the Carter administration that we don't quite understand yet, at least at the agency level:

the minimal use of consultants and advisory bodies to the federal agencies. We don't know exactly what that means. We have been stripped of quite a few advisory bodies in our own agency. We have been allowed to keep our advisory body to the National Institute. With respect to consultants, I don't know what it means. Does that mean that we should do more research in-house, because we use many consultants to evaluate research, to procure very small things which are associated with research? We don't know what the impact of that particular thing is. We think that it could affect our efficiency and productivity of our research.

Session 6

FUTURE REQUIREMENTS FOR R & D EFFECTIVENESS

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The Great Experiment

Since World War II our government has been engaged in a great experiment in the use of procurement to perform r & d (research and development) tasks. Prior to the war, 90 percent of this work was done in government arsenals and like installations. Then, during the war, government and industry joined forces in a mammoth r & d effort to produce the atom bomb. The success of this enterprise undoubtedly served to encourage the development of the contract system. As a result, whole new industries were established, new technologies were invented and technological development was generated at the fastest pace in the history of man.

Moreover, this activity stimulated a revolution in the field of management. Under the auspices of the Deparment of Defense contractor management programs, PERT (Program Evaluation and Review Technique), PPP (Phased Procurement Planning), and PPBS (Planning, Programming, Budgeting Systems), were developed. A large-scale, decentralized r & d operation, that many governments would have been reluctant to attempt, performed successfully. The ultimate test was the moon landing, which was the product of the efforts of a government agency plus tens of thousands of contractors. The United States assumed world leadership in r & d. The contract/grant system became a proven way of promoting innovation through the collaboration of government, industry, universities, and nonprofit organizations. Although this system was not without its faults, it proved to be a reasonably good fit to the requirements of the r & d task.

The agency-contractor system offered flexibility in programming, directing, managing information flows, and in the use of resources. There was the potential for the test of the market and the quality of output to serve as regulators of activity. The "activity-oriented" permanent government bureaucracy was replaced by a joint enterprise that was "achievement-oriented" and flexible. When objectives were not being realized, it was simpler to close down a Dynasoar program and lay off Boeing workers than it would have been to shutdown a government facility employing career civil service personnel.

The system also provided a good fit with certain of our economic and cultural values. We developed a type of federalism by contract. The contract system is congruent with the political judgment that the best government is small government. With this system the government is able to undertake a large amount of activity without a concomitant growth in federal government.

Procurement rather than government in-house activity became the vehicle for promoting effective r & d. In the process a number of distinctive approaches to the agency-contractor relationship were developed.

Grants programs for r & d involve the greatest freedom for recipients, a freedom which they deem absolutely essential. In initiating the grant-awarding process, an agency announces support for work in a given area and requests proposals. The proposals submitted are then evaluated by review committees composed of peers of the proposal writers. This process stresses research merit, and if the process is functioning well, slipshod research will be screened out and high quality projects will be selected. The hoped-for output of the system is two-fold: advances in science and technology and the development and strengthening of recipient institutions. Agency-initiated controls are minimal or nonexistent because for a long time the world of federal grants to profit and nonprofit research institutions, universities, and hospitals was thought to be self-regulating.

Contracts differ from grants in a number of ways. In the first place, contracts involve r & d work closely allied to and relevant for an agency's needs. In the second place, this relationship has never been regarded as totally self-regulating. In fact, controls are almost universally regarded as essential.

In all cases the contract imposes substantial constraints on the relationship. The document specifies time limits and other conditions for completion of the assignment. The nature of the product may be precisely defined, and final payment awaits delivery. Financial controls are an important feature. They vary all the way from the comforts of "cost plus" and generous progress payments to a stringent "fixed price" model. In addition, a seemingly endless variety of economic incentive systems has been developed, some so complex as to defy implementation. Given the uncertainties in the r & d process, agreement on appropriate controls has been slow in coming, and as a result, this aspect of the agency-contractor relationship has been the subject of much experimentation.

Cultural values have favored a market-type model as the ideal for the agency-contractor relationship, but in practice the constraints involved in doing business with the government have led to the establishment of organizations or units within organizations that specialize in this particular work. Thus, a dependency-type "off-market" relationship has developed in many cases.

The technological characteristics of a particular agency's work impose further constraints on the relationship. The differences between the Department of Defense (DOD) and the National Aeronautics and Space Agency (NASA) are a case in point. DOD's missile and aircraft development programs, with their large follow-on production orders, permit a relationship in which the agency relies heavily on the contractor for technological expertise and on systems techniques for control. NASA, on the other hand, produces one-of-a-kind spacecraft and cannot tolerate errors in their design and production. NASA thus employs a system for close monitoring of contractors supported by an in-house capability sufficient to assure the quality of the monitoring effort.

Certainly, all parties directly and indirectly involved in this great experiment would agree that there is no one best way to conduct the r & d agency-contractor relationship in order to achieve effective performance. The demands of the environment, the task, the nature of the individuals and organizations involved require organizational arrangements tailored to fit each particular case.

No one claims that the style of r & d contracting developed in the hay-day of the 1950s and the 1960s was ideal. Several congressional committees raised issues such as cost overruns and systematic biases in agency-contractor relationships. However, in making critical analyses, one can become so obsessed with finding faults that one fails to observe the strengths of the system. Too often one then proceeds to focus reforms on the curbing of faults rather than on attempts to build on strengths.

Recent Developments

Recent developments indicate that the past as we have known it will not continue. We will set forth new pressures for change and then proceed to examine their likely impact on the agency-contractor relationship and on the effectiveness of the r & d produced by it: Is the state of the present admittedly imperfect fits between the r & d task and organizational arrangements likely to be worsened or improved?

Within the past 5 years at least two major changes have taken place in the field of federal r & d grants and contracts. The first is the economic crunch which has caused the agencies to search for "fat" in their budgets. Unfortunately, a high proportion (85 percent in some cases) of these budgets represent fixed obligations. R & D grants and contracts are one of the few sources of flexibility. In addition, when budget cuts threaten staff members' jobs, contracted out r & d tasks provide a source of work that can be pulled inside, and civil service unions have been pressuring for this course of action. In the process, funding for externally conducted r & d has not only been reduced, it also has become unstable. The contractor who relies on a steady flow of federal grants and contracts is faced with an uncertain future.

The second change involves a shift in emphasis. Given the ample funds of the 1950s and 1960s, innovation in weapons and space technology pushed the state of the art in these fields far beyond that which prevailed in the civilian world. This self-generating innovation led to an imbalance in the economy and fostered pressures to equalize by investing more heavily in social programs. While space and defense are far from being put out of business, Health, Education, and Welfare (HEW) is the rising star and social programs have become the big growth area in federal spending for r & d. However, in part because of the pressures described above and in part because the technology involved is less complex, HEW has been less inclined to contract out r & d.

As a result of the above trends, the government has moved away from relying on contractors as heavily as it once did. In 1960, 91 percent of all r & d was contracted out, while in 1976, the proportion was 72 percent. By way of example, in 1977 HEW contracted out only one-fourth of the 2 billion dollars it spent on program evaluation research.

Today we are faced with what the contractor can only regard as an unenviable situation: less activity and less stable funding combined with greater pressures on and criticism of the r & d work that is being funded. In 1977 much publicity was given to federally supported r & d blunders and scandals. A highly critical Senator William Proxmire named the Department of Transportation the August winner of his Golden Fleece of the Month Award for a $225,000

contract with the Stanford Research Institute to forecast transportation needs in the year 2025 under hypothetical conditions that included guerilla warfare and the establishment of a dictatorship. The following finding was reported: "In the event of guerilla warfare, automobile use in affected regions would become risky."[1] Readers, who have no access to information that would verify whether or not the above quote fairly represents the work in question, are easily led to the conclusion that all government-supported social science r & d is a waste of money if not an outright fraud.

Late in September 1977, there arose cries of scandal concerning r & d funds management. The pooling of funds from various grants is a long-time practice of institutions engaged in government-supported r & d. The practice developed because both funders and contractors have difficulty arranging the flow of funds to meet a project's immediate needs. An agency may supply funds months after work on a project has already commenced. In the meantime, to meet expenses the contractor uses funds received for work on other projects. This constant juggling of monies represents an accommodation to real life pressures. A project begins with a proper budget, and in the final accounting the proper amounts will have been expended in each category, but in between there exists a condition that may be characterised either as "needed leeway" or as "law breaking."

In the case in point, a young assistant professor at Harvard alleged that he had been directed to sign blank forms vouching for the way in which his National Institutes of Health (NIH) grant monies had been spent. The Department of Nutrition at the School of Public Health then filled them in with unrelated items and forwarded them to the government. NIH found that these allegations were true and at the same time uncovered serious accounting problems in two other grants. Harvard was asked to pay back $132,349 for misspending on all the grants, and an audit was begun on the total of $400 million in federal funds that the school receives.[2]

Agency Activism

Clearly, the pressure is on. Bureaucrats are being told to "straighten out" the situation in r & d. The issues that have surfaced are partly effectiveness and partly control, with the former serving as the object of rhetoric and the latter as the object of action plans.

What has been happening in response to the pressures? Most notably, agency activism is on the upswing, as evidenced by the following developments:

- Results (outputs not inputs) are being stressed. In the process, government funding is being accompanied by pressures to do targeted applied research rather than basic research with its long gestation periods and risk that it may not yield practical spinoffs. These pressures are generated by demands from many in and out of politics for faster payoffs from the investment in federal r & d.

- Measurement and evaluation of the results of federally supported r & d are being stressed. New political attitudes demand some kind of human justification for research. In part to satisfy this demand, output indicators are being developed. In addition, awards

of federal funds are now accompanied by a requirement for follow-up evaluation research. The allocation of funds for ex post facto evaluations is growing by leaps and bounds.

- Accountability is being stressed. More and more is required in the way of time and effort reporting, monthly certification, detailed justification, guaranteed schedules, and affirmative action plans. Some observers maintain that r & d managers are becoming mere paper shufflers.

The availability of appropriate management systems has both contributed to and supported these developments. Planning Programming and Budgeting Systems (PPBS), with emphasis on input-output analysis, have provided managerial tools for furthering the new era in r & d controls. PPBS has created a climate demanding analysis. Some bureaucrats have latched onto PPBS, for they see in it a golden opportunity. Billions of dollars are involved in meeting the demands of projected federal PPBS programs, and these programs will create hundreds and even thousands of new careers.

However, PPBS also asks much of the agency that uses it. Questions of priorities, comparative costs, benefits, effectiveness, and resource inputs and outputs are raised routinely. In addition to developing plans and priorities for its own work, an agency must coordinate with other agencies in order to participate in overall r & d planning and policy making. Some unhappy decisions may have to be faced. A particular agency's r & d project may appear to be cost-effective in its own right, but in the overall scheme of things a more productive use may appear for the funds this project was hoping to receive.

A troubling question immediately arises concerning these developments: Are the critics who deplored the looseness in the old agency-contractor relationship about to render r & d unproductive and ineffective in the process of tightening up? The old ways were far from ideal, but there was a semblance of a fit with the requirements of r & d work in terms of flexibility. Will the new system lead to increasingly bad fits between the r & d task and the organizational arrangements involved, which in turn could serve to severely diminish the quality of the output?

What will be the impact of these developments on the agency-contractor relationship? The pressures on an agency to come up with a total r & d plan can lead that organization to move into the contractor's realm with force, to the extent that the contractor may become little more than a "body shop," an extension of the agency, providing the personnel for its closely specified tasks.

In addition, as the requirements for much paperwork and reporting and specifically targeted research become well known, it is possible that new sets of contractors will spring up, ready and willing to meet these demands. They will fulfill immediate requirements, but might not the long-run worth of their contributions be open to question? The agency could lose valuable contractor inputs in the process of narrowly specifying outputs and thus severely delimiting the contractor's role.

In this new planning milieu, what will happen to some of the time-honored r & d institutions designed to assure productivity and effectiveness? Peer review for project selection is an example. PPBS and cost/benefit analysis perform the identical function. Critics see peer review as nothing more than an "old boys network" in operation, but students of the subject maintain that it is the best means for selecting research proposals that will prove to be productive.[3] Still, the question remains: If peer review loses out, will the judgments that replace it be of equal quality in terms of the results produced?

Assessment and Analysis

Experts in the field of management maintain that effective r & d requires flexible organizational arrangements: informal, decentralized structures that permit on-the-spot decision making in response to new discoveries, information, or unexpected developments. The task environment is highly uncertain and as a result, those working in this field require organizational and decision structures that enable them to cope with this uncertainty.

Perhaps an encouraging note is sounded by Pelz, who in his comprehensive research on r & d personnel found that they were most effective in their work when they faced challenges which provided "creative tensions." Thus, the researchers' best work was produced when they devoted one-fourth of their time to either administration or teaching.[4] It is possible that the interface with agency activists will surface some of this needed tension, but somehow we doubt it. The tensions created are likely to be overwhelming, for as we have noted, a bad fit is in the process of being developed between the r & d task and the organizational arrangements designed to control it.

We must look critically at the implications of systems analysis. It suggests that central administrators and their staff analysts can compare the outcomes of different r & d proposals and make tradeoffs on the basis of future-oriented analyses in order to select the best alternative. This, in turn, implies a degree of control over r & d programs, expenditures and decision making which may not be present.

Social programs r & d, the major growth area, is a case in point. If we want to resolve our social problems on a systems basis, but through a decentralized system of contractor participation, we will somehow have to develop much more knowledge of these problems and of means for coping with them. Desired outputs can then be specified and results measured and evaluated. If this knowledge is lacking, and we still want to proceed with contracting on a systems basis, then we will be obliged to surround the r & d process with regulations, rules, limits, standard contracts, "boiler plate," and rigid specification of inputs. To some extent, at least, this is a description of the present situation.

Where the federal government is concerned, systems politics and process politics will always co-exist. Systems politics focuses on results and outcomes and not on what is done to get them. Process politics involves the interaction of interest groups and the striking of bargains that represent not a desired outcome, but "the best we can get, given the situation."

If systems politics denies the outcomes that a group of program constituents or r & d contractors seek, it is very likely that they will take the process politics route to achieve their objectives. The systems manager who feels that he/she is the only decision force for a given program is living in a dream world. In the social program area, especially, the interaction between systems politics and process politics can be very intense. Public services and jobs are involved. PPBS originated in the Department of Defense, and it is likely that defense programs are much more amenable to systems controls than are those involving the civilian world.

If we are to avoid vast control mechanisms and centralized agency regulation of federally supported r & d, we need to have appropriate pressures and incentives built into the programs that provide support for r & d. This is the great value and strength of the free market system. If we unwittingly incentivize cost overruns, we will get them. If we institute stringent controls aimed at overruns, we may create a system that overpowers and enfeebles the basic r & d activity. We must learn to incentivize the behaviors we desire.

Taking a cue from the free market model, excellence in r & d can be induced by designing a self-forcing (for excellence), self-enforcing (for control) system that includes both agency and contractors. To achieve this goal, a pressure/incentive system must be devised that will function to correct significant errors and prevent major distortions from arising. Relying heavily on indirect means, the agency designs a system that provides pressures in the right direction so that most of the time the system will stay on course. The choice of a strategy is a function of various factors such as the technology involved. There is no one best strategy.

In general, the agency will want to insure that some of the basic conditions for effective r & d are present. For instance, needed information exchanges must take place and problems must surface and be identified almost as soon as they arise. Some means must exist for following problems until they have in fact been resolved.

For example, the greater the interdependence among the units (contractors) involved in an r & d project, the greater is the probability that cooperative work relationships will develop, and thus, a self-forcing system will emerge. Contracturally imposed requirements are of little use in building such pressures, for there is no way of defining in advance the amount and quality of interchange needed between two organizations that must cooperate to assure successful completion of a given project. If two r & d contractors are apt to have to work together at some point to resolve shared problems, it is advisable to avoid the selection of two organizations that normally compete with one another. Rather, one should select two organizations that will continue to need one another's good will in the future.

The ex post facto evaluation research so popular in PPBS provides information about problems after they have become a part of history. However, to induce excellence, the r & d system needs to be incentivized to surface problems as they arise. Problems then can be dealt with effectively and out in the open, quickly enough to take timely action and to ensure that all those actually and

potentially affected will have the information they require. NASA's r & d programs required this type of visibility, and after the Apollo fire, the agency introduced the use of a data bank to routinely enter all unresolved problems relating to a particular program. This system was implemented with the aid of a skillful systems integration contractor. It proved effective because as a top manager put it, he did not have to issue orders to a delinquent contractor: "Organization A knows it, Organization B knows it, Organization C knows it, I know it, and the offender knows we all know it. He feels compelled to take action."[5]

Incentives that properly guide what is done in the course of a program or project are equally or even more important than those attached to the end product, which is, after all, the result of the activity which preceded it.

The agency-contractor system has proven to be an effective means for bringing together a variety of talents and resources to attack the r & d problems our country needs to solve. Building incentives and pressures into our r & d programs is one means for assuring effective performance. We should pursue experimentation in this direction.

In the opinion of this writer, it is simply too early to "lock into" systems (PPBS) approaches with their strong emphasis on outputs. We need a broader base of knowledge and expertise, especially in the field of social programs, before we move to an approach of this type. As we are not now in a position to initiate a well-planned controlled r & d system, it seem wiser to concentrate on improving the effectiveness of the agency-contractor relationship that has served us so well.

NOTES

1. New York Times, Dec. 5, 1977.

2. "Research Management Scandals Provoke Queries in Washington," Science, 198, Nov. 25, 1977, pp. 804-06.

3. Stephen Cole, Leonard Rubin and Jonathan R. Cole, "Peer Review and the Support of Science," Scientific American, 237(4), Oct. 1977, 34-41.

4. D.C. Pelz and F.M. Andrews, Scientists in Organizations: Productive Climates for Research and Development (New York: Wiley & Sons, 1966), Ch. 4.

5. Leonard R. Sayles and Margaret K. Chandler, Managing Large Systems: Organizations for the Future (New York: Harper & Row, 1971), p. 114.